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THE SPACE SHUTTLE PROGRAM IN TRANSITION:
KEEPING SAFETY PARAMOUNT

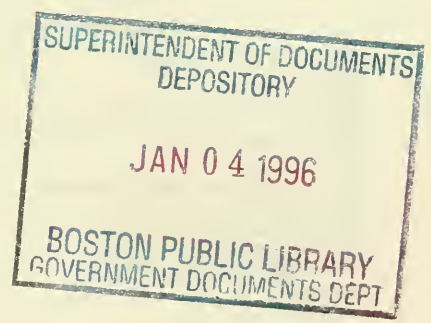
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HEARING
BEFORE THE
SUBCOMMITTEE ON
SPACE AND AERONAUTICS
OF THE
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES
ONE HUNDRED FOURTH CONGRESS
FIRST SESSION

SEPTEMBER 27, 1995

[No. 20]

Printed for the use of the Committee on Science



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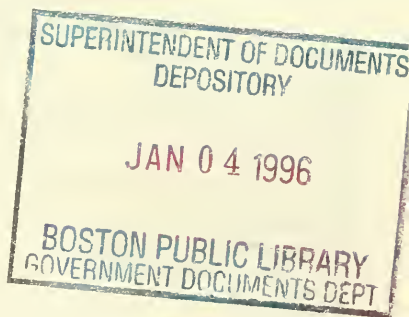
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**Vice Chairman

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THE SPACE SHUTTLE PROGRAM IN TRANSITION: KEEPING SAFETY PARAMOUNT

WEDNESDAY, SEPTEMBER 27, 1995

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE,
SUBCOMMITTEE ON SPACE AND AERONAUTICS,
Washington, D.C.

The subcommittee met at 1:05 p.m. in Room 2318 of the Rayburn House Office Building, the Honorable F. James Sensenbrenner, chairman of the subcommittee, presiding.

Mr. SENSENBRENNER. [Presiding] The Subcommittee will be in order. Good afternoon, ladies and gentlemen. We are convening the Subcommittee on Space and Aeronautics today to consider the operational safety of the Space Shuttle, NASA's only means of continuing the human exploration of space, and the lynch pin of America's participation in the International Space Station program.

Since the first flight of the Columbia in 1981, the Space Shuttle has proven itself a technological marvel. Today, it is the most complex spacecraft in operation anywhere in the world.

NASA, it's contractors, and the American people have much to be proud of in the continuing success of shuttle operations since the 1986 Challenger tragedy.

The ability of our space program to bounce back from such a significant blow demonstrates the skill, dedication, and expertise of America's space community. The shuttle program is undergoing a period of change.

First, NASA is moving toward a single prime contractor to reduce the cost of shuttle operations by streamlining bureaucracy.

Despite its technological successes, the Space Shuttle remains one of the most expensive means of placing people and payloads into orbit. Moving to a single prime contractor will help reduce this cost. And more importantly, a single prime contractor may contribute to safety improvements by improving accountability and oversight as the shuttle work force review concluded earlier this year.

My major concern is what happens between now and the time the single prime contractor arrangement is fully operational.

Second, we must continue to exercise care and caution when it comes to matters of shuttle safety. The recent launch delay is attributed to scorching of O-rings in the solid rocket boosters were eerily reminiscent of the problems that led to the Challenger disaster.

Fortunately, NASA caught the flaws before they caused harm, and appropriately ground the shuttle fleet until it understood and

corrected the problem. We should all applaud NASA for placing safety first.

Certainly, the recent report by the Science Applications International Corporation concluded that shuttle safety had improved from the mid-1980s is welcome news, and tells us a lot about how NASA has improved shuttle operations.

Nevertheless, there are many concerns about shuttle safety. We have seen the resignations of two individuals directly responsible for shuttle operation and safety in the last year. General Jeremiah Pearson, of course, was Director of Human Space Flight, and Robert Crippen was Director of the Kennedy Space Center. That gives me pause.

Also, we must not forget the O-ring problem, even though it was appropriately and successfully resolved. But most importantly, with the downsizing of NASA, the reducing of the work force, and the restructuring of remaining NASA operations gives me concern that we will not have the appropriate number of people making sure that the Space Shuttle remains safe.

Because if the Space Shuttle goes out of operation, then so goes America's participation in the International Space Station, and we will see a Russian-led space station, a result that none of us desire.

For these reasons, this hearing comes at a critical time, and we all welcome the input of our distinguished panel of experts.

Now, I'd like to recognize the distinguished gentleman from Texas, my friend, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman. And I certainly appreciate your remarks.

I appreciate this panel, and I do recognize that, looking at the witness list, that it's an above-and-beyond panel, and of course I'm always glad to see my old friend, General Stafford. He's testified before us many times, as others have.

And I've been able to call on Dr. Hans Mark, for whom I have the highest and greatest respect through the years as I served as Chairman, and I thank you for that friendship and support. And when you go back to the University of Texas, I don't care anything about you talking to the coach about the boys; talk to the scheduler, and try to keep Notre Dame off our schedule for the next two, three, four years. We don't need to go back to South Bend anymore. Mr. Chairman,—

Mr. SENSENBRENNER. There's always an excuse.

Mr. HALL. That was the scheduler. It was just 18 months ago that General Jed Pearson, NASA's Associate Administrator for Space Flight, testified before this subcommittee on the challenge of maintaining shuttle safety, and I think safety is a buzz word for me and for us and should be for this Congress.

Talked about safety in the midst of budget cuts, and for a long time probably the various and different administrators would, when we'd try to cut the budget, they'd run at us with safety, and that's hard to fade because nobody wants to thwart safety.

I think they've gotten away from that, and whether or not you really like the present NASA administrator, I think he's given us some cuts that were meaningful cuts that have gone about as far as the cuts can go.

And we're working hard to reduce the budget, and I certainly share the concerns that you men at that table have and those with whom you work, and this good Chairman, I share concerns about safety.

I want to know that my commitment again that I don't want to ever be standing in front of you gentlemen and ladies and say that I haven't done everything I thought I could do to ensure the safety of our space flight.

General Pearson is not here today. He resigned ten months ago. And a month after General Pearson's resignation, Bob Crippen, the very able Director of the Kennedy Space Center and former shuttle astronaut, also resigned.

In a December 19, 1994 article in Space News, Mr. Crippen is quoted as saying, and I quote:

The whole system as I see it, both external and internal, is to try to drive the cost down, he said. It's just got to the point where I'm not comfortable with it anymore.

Bob Crippen was very knowledgeable. He'd *flow* the flight, he'd walked the walk, and I think he's about as knowledgeable as anybody in the program.

And I'm concerned that he left with that on his mind, and perhaps that is one of the things that caused him to leave.

And since then, the Deputy Associate Administrator for Space Flight and the Shuttle Program Director have also decided to leave NASA.

So it's appropriate, I think, Mr. Chairman, that we as members of NASA's Oversight Committee, take these expressions of management's dissatisfaction very seriously.

We also continue to hear reports of concern among shuttle managers that budget cuts are being made at too rapid a pace, and about reports of low morale among the shuttle work force.

Well, we, as members of the subcommittee are obviously not experts in safety, so we have to listen to those of you all who are, and of those of others who are.

To summarize what we've heard, there's a real mixed blessing regarding the level of safety today and whether NASA can absorb the budget cuts mandated in the FY '96 budget.

Now, I've been one that since I've been here, have seen very few budget cuts that I didn't like, but I've also seen budget cuts that I did like, and I like the way NASA's cut their budget since 1993, some 34 percent of their budget's been cut.

I like the way that they responded when the President said you've got to take another \$5 billion out of it. I don't know of any other agency or any other entity in this Congress that's kept the faith with the people anymore than the NASA budget has. And of course, that's been at the suggestion of the Chairman here and of the Chairman of the Committee, George Brown, back then, and of course the present Chairman, Mr. Walker.

So I think there's a continuous consensus that the additional budget cuts that have been discussed this year are going to impact on this situation even more.

So my concern, Mr. Chairman, is reinforced by the written testimony of one of today's witnesses, Mr. Johnstone, the Chairman of

the Aerospace Safety Advisory Panel. And he warns, and let me quote right out of his warning, quote:

There is the distinct possibility that overzealous reductions in the work force and NASA budgets, while at the same time retaining tight schedule pressures, may introduce increased levels of risk and jeopardize space shuttle safety.

NASA cannot continue to launch space shuttles back to back and compress schedules while at the same time reducing its work force to a bare minimum.

So that's a pretty clear warning and I think we need to pay attention to his words.

It would be easy for today's hearing to turn into a discussion of contracts and organizational boxes, but we shouldn't let that happen. The reality is that all the streamlining and consolidation of contracts, personnel reductions and other cost reduction measures that we're going to hear about today are an attempt to meet the President's five-year budget plan.

And what's been left unsaid is that the House republican budget proposal directs NASA to cut another \$1.5 billion from the shuttle program during the same period. I'm not convinced that NASA can absorb any more cuts.

The \$1.5 billion cut will inevitably trigger additional massive civil service and contractor job losses at the Kennedy Space Center, the Johnson Space Center, the Marshal Space Flight Center at a minimum.

In addition, it will drastically disrupt the shuttle program at a critical time, just when we're depending on the shuttle to assemble the space station.

So I know that there does exist bipartisan consensus on this subcommittee that we must not undermine the space station program by being penny wise and pound foolish.

I welcome today's hearing and any related hearings that we might have in the future, Mr. Chairman. I thank you and I yield back my time.

Mr. SENSENBRENNER. Thank you, Mr. Hall. Without objection, opening statements by other members of the subcommittee will be included in the record at this time.

[The prepared statements of Mr. Sensenbrenner, Mr. Hall, Mr. Brown and Mr. Weldon follow:]

Hearing on Space Shuttle Safety
September 27, 1995
Opening Statement
The Honorable F. JAMES SENSENBRENNER, JR.
Chairman
Subcommittee on Space and Aeronautics

Good morning ladies and gentlemen. We are convening the Subcommittee on Space and Aeronautics today to consider the operational safety of the space shuttle, NASA's only means of continuing the human exploration of space. Since the first flight of the Columbia in 1981, the space shuttle has proven itself a technological marvel. Today it is the most complex spacecraft in operation anywhere in the world. NASA, its contractors, and the American people have much to be proud of in the continuing success of shuttle operations since the 1986 Challenger tragedy. The ability of our space program to bounce back from such a significant blow demonstrates the skill, dedication, and expertise of America's space community.

The shuttle program is undergoing a period of change. First, NASA is moving towards a single prime contractor to reduce the cost of shuttle operations by streamlining bureaucracy. Despite its technological successes, the space shuttle remains one of the most expensive means of placing people and payloads in orbit. Moving to a single prime contractor will help reduce this cost. More importantly, a single prime contractor may contribute to safety improvements by improving accountability and oversight, as the Shuttle Workforce Review concluded earlier this year.

Second, we must continue to exercise care and caution when it comes to matters of shuttle safety. The recent launch delays attributed to scoring of O-rings in the Solid Rocket Boosters were eerily reminiscent of the problems that led to the Challenger disaster. Fortunately, NASA caught the flaws before they caused harm and appropriately grounded

the shuttle fleet until it understood and corrected the problem. We should all applaud NASA for placing safety first. Certainly the recent report by the Science Applications International Corporation that concluded shuttle safety had improved from the mid-1980s is welcome news and tells us a lot about how NASA has improved shuttle operations.

Nevertheless, some concerns remain about shuttle safety. We have the resignations of two individuals directly responsible for shuttle operations and safety in the last year. General Jeremiah Pearson, was of course, Director of Human Spaceflight and Robert Crippen was Director of the Kennedy Space Center. This gives me pause. And, we must not forget the O-ring problem, even though it was appropriately and successfully resolved.

For these reasons, this hearing on shuttle safety comes at a critical time and we can all welcome the input of our distinguished panel of experts.

**OPENING STATEMENT
of**

HON. RALPH M. HALL

September 27, 1995

Good afternoon. It was just 18 months ago that General Jed Pearson, NASA's Associate Administrator for Space Flight, testified before this Subcommittee on the challenge of maintaining Shuttle safety in the midst of budget cuts. In response to a question of mine he replied:

"We're working very hard to reduce the budget. I share your concerns with the safety, but I want you to know my commitment, again, that I don't ever want to be standing in front of you gentlemen and ladies and say that I haven't done everything I thought I could to ensure the safety of our space flight."

General Pearson is not here today. He resigned 10 months ago.

A month after General Pearson's resignation, Robert Crippen, Director of the Kennedy Space Center and former Shuttle astronaut, also

resigned. In a December 19, 1994 article in Space News, Mr. Crippen is quoted as stating:

"The whole system as I see it, both external and internal, is to try to drive the costs down,' he said. 'It just got to the point where I'm not comfortable with it anymore."

Since then, the Deputy Associate Administrator for Space Flight and the Shuttle Program Director have also decided to leave NASA. It is appropriate that we, as Members of NASA's oversight committee, take these expressions of management dissatisfaction seriously. We also continue to hear reports of concern among Shuttle managers that budget cuts are being made at too rapid a pace, and about reports of low morale among the Shuttle workforce.

We the Members of this Subcommittee are obviously not experts in safety so we must listen to those that are. To summarize what we have heard, there is a real mixed message regarding the level of safety today and whether NASA can absorb the budget cuts mandated in the F.Y. 96 budget. There is almost a consensus that the additional budget cuts that

have been discussed this year will certainly impact this situation even more.

My concern is reinforced by the written testimony of one of today's witnesses, Mr. Johnstone, the Chairman of the Aerospace Safety Advisory Panel. He warns:

"There is the distinct possibility that over-zealous reductions in the work force and NASA budgets, while at the same time retaining tight schedule pressures, may introduce increased levels of risk and jeopardize Space Shuttle safety. NASA cannot continue to launch Space Shuttles back-to-back and compress schedules while at the same time reducing its work force to a bare minimum."

That's a pretty clear warning, and I think that we need to pay attention to his words.

It would be easy for today's hearing to turn into a discussion of contracts and organizational boxes, but we shouldn't let that happen. The reality is that all of the streamlining and consolidation of contracts,

personnel reductions, and other cost reduction measures that we will hear about today are an attempt to meet the President's five-year budget plan. What has been left unsaid is that the House Republican Budget proposal directs NASA to cut another \$1.5 billion from the Shuttle program during the same period. I am not convinced that NASA can absorb any more cuts.

That \$1.5 billion cut will inevitably trigger additional massive civil service and contractor job losses at the Kennedy Space Center, the Johnson Space Center, and the Marshall Space Flight Center—at a minimum. In addition, it will drastically disrupt the Shuttle program at a critical time: just when we are depending on the Shuttle to assemble the Space Station. I know that there does exist a bipartisan consensus on this Subcommittee that we must not undermine the Space Station program by being penny wise and pound foolish.

I welcome today's hearing, and any related hearings we are planning in the future. Thank you.

STATEMENT BY GEORGE E. BROWN, JR.

Mr. Chairman, I want to commend you for calling this hearing today. As a Member of this Committee at the time of the Challenger accident, I am keenly aware of the need for continuing, strenuous Congressional oversight and attention to safety.

Today, as was the case in 1986, we must ultimately put our faith in the NASA managers and shuttle personnel to ensure a high level of safety. But we in Congress continue to have a separate and equal responsibility to ensure that there is a system in place to track safety trends, catch human mistakes, and properly air safety concerns. Today's hearing is an important part of that process and we will examine NASA's side of this issue in great detail.

However, we also have a responsibility to make sure that we on the Authorizing Committee are providing the proper level of resources to this program so that the limits of safety will not be stretched. I am deeply concerned that we have ignored this part of the issue, the part we on the Committee are solely responsible for.

The budget resolution which came out of the Budget Committee and we faithfully followed on this Committee has established a \$1.5 billion reduction to the Shuttle program over the next five years. I am not aware of any hearings, any oversight, or any explanation whatsoever to determine what the basis of this mandate was and whether NASA can actually cut another \$1.5 billion from the Shuttle program and maintain safety. Yet we will ask NASA to take on this enormous responsibility.

Thus I am left with the fundamental question "Which Shuttle program will we be examining today?" Will we look at the program NASA has laid out, the one the witnesses are familiar with? Or are

we looking at the Shuttle program Congress has told NASA they must have? If that is the case, I feel we should begin by asking exactly what this program is. I do not feel the witnesses can shed much light on this question.

Opening Statement of Rep. Dave Weldon of Florida

**Hearing of the Subcommittee on Space
The Space Shuttle Program in Transition: Keeping Safety Paramount**

September 27, 1995

I want to thank the Chairman for this hearing on shuttle safety at this early stage in NASA's effort to move the operation of our space shuttle fleet to a single prime contract. I thank the witnesses before us who offer us a wide range of experience to draw from.

Last month I held a day-long town meeting with the employees of Kennedy Space Center. One theme that was mentioned repeatedly, is their concern over the safe operation of the shuttle. These are the people on the front line. They know the dangers. They know about the safety concerns first hand.

Our manned space program is second to none. It's a system that works safely and delivers consistently. Members of the shuttle team at Florida's Kennedy Space Center, at mission control in Houston and throughout the agency are well-trained, dedicated, and talented professionals. I'm convinced that safety is the prime focus of Shuttle workers.

The concerns I have heard from workers in the trenches, is that the direction NASA is taking towards a new and reorganized shuttle program, may not provide the structure necessary for retaining that same dedication to safety. I am committed to insuring that decisions about the future operation of the shuttle are not driven from the top down. We must have the full participation of the people who do the work.

I sincerely hope that the voices of those coming from the rank and file will be heard and acted upon by upper management. We are here today, to begin to explore in greater detail some of the concerns that they are raising about the continued safe operation of the shuttle fleet.

I'm holding in my hand, the report of the Presidential Commission on the Space Shuttle Challenger Accident. The Challenger accident was the most traumatic event in the history of our space program, and much of the current shuttle management philosophy is rooted in the findings in this report.

The safety of our shuttle program is essential to the future of our human space flight program. Indeed, if the shuttle is not operated safely, we will have no human space flight program.

I was pleased with the overwhelming vote of this Congress to move forward with the International Space Station. This year the Space Station received its largest vote of support in the history of the program.

The space shuttle is an integral part of both building the space station and providing us with access to the station once it is completed. In fact, when asked about the shuttle back in June, Administrator Goldin said, "We're going to build the station, and the shuttle is the backbone."

Clearly, we must carefully guard the safety of the shuttle, ensuring that Mr. Goldin's proposal to move to a single prime contract does not in any degree compromise this safety, but rather enhances safety.

Just a few weeks ago we were reminded once again how critical a well-trained and experienced ground crew is -- when they noticed erosion on the primary O-ring in the Redesigned Solid Rocket Motor (RSRM) nozzle joint.

The problem was correctly identified as a safety concern, brought to the attention of the program office, and the mission was delayed. This proves that the current system works and this team is to be commended.

For the sake of our human space flight program, we must ensure that this safety valve continues to work as effectively as it has for the past 46 missions. Over these 46 missions, the space shuttle team has made putting the space shuttle into orbit look easy. However, this is a very complex system and there is zero room for error.

The taxpayers have spent billions of dollars on this program. Thousands of individuals have dedicated their entire career to developing and safely launching the space shuttle. Untold sacrifices have been made to see that this program works, and that it works well.

As NASA moves forward with its plan to move to a single prime contractor, we must ensure that those putting the taxpayer's shuttle into orbit do so with the same degree of safety.

This Subcommittee has the responsibility of closely scrutinizing NASA's operation of the space shuttle, including NASA's proposed transition to a single prime contract and the operation of that contract.

This hearing is the first of what will be a series of hearings on the safety of the shuttle program and oversight of NASA's proposal to move to a single prime contract.

I look forward to today's hearing.

Mr. SENSENBRENNER. The five members of this afternoon's panel are, first, Dr. Wayne Littles, Director of Human Space Flight for NASA.

Second, Mr. Joseph Fragola, the Vice President and Manager of the Advanced Technology Division of the Science Applications International Corporation of New York.

Third, Mr. Paul Johnstone, Director of the Aerospace Safety Advisory Panel of NASA.

Fourth, Dr. Hans Mark of the Department of Aerospace Engineering and Engineering Mechanics of the University of Texas at Austin.

And finally, an old friend of this subcommittee, Lt. General Tom Stafford, of Stafford, Burke & Hecker of Alexandria, Virginia. First, Dr. Littles, you are recognized, and you may proceed as you wish.

STATEMENT OF DR. J. WAYNE LITTLES, DIRECTOR OF HUMAN SPACEFLIGHT, NASA HEADQUARTERS, WASHINGTON, D.C.

Dr. LITTLES. Thank you, Mr. Chairman. Mr. Chairman and members of the subcommittee, I'm pleased to present my statement for the record regarding safety as it relates to the Space Shuttle program restructuring.

The Space Shuttle program restructuring will achieve increased contractor accountability and responsibility, reduce the role of the government work force in routine operations, reduce requirements and reduce costs.

Our overriding consideration is to continue to fly shuttles safely during the transition to a modified management contract and work force structure, and to maintain safety in the restructured program.

To accomplish this, each element of the restructuring activity is being assessed to define the changes required, to assess potential risk, and to develop a transition plan.

Considering the maturity of the shuttle's day to day operations, we feel that now is the time for the government to change its role from supervising or overseeing the routine operations to one of audit and penetration into out-of-family situations.

Each operations task presently being conducted by the government is being reviewed for elimination, continuation, or transition to a contractor.

We will maintain sufficient technical insight into contractor activities to ensure independent assessments for safety committing to flight.

I also have directed that an improved audit system be implemented across the shuttle program. This new process places emphasis on all aspects of hardware manufacture and assembly and will improve overall safety.

The audit system, coupled with surveillance and detailed technical insight, will provide essential data for our commitment to flight decisions.

Teams are reviewing all document requirements to program operational experience and hardware/software performance. Revised requirements will be implemented within the next few months but these changes will also be carefully planned and implemented.

In conjunction with the plans for transition of government operations tasks to contractors, a revised, streamline management plan is being developed by the program management team.

This plan will be a critical part of our transition planning. A key element of our planning is to maintain sufficient technical insight into contractor activities to identify and assess problems.

We will also continue to ensure technical, schedule, and cost performance for the single prime contractor and subcontractors with our contract fee structure.

We're developing plans for consolidation of shuttle-related contracts and focusing operations aspects of these contracts under a single prime contractor.

In making this change, we will improve safety by focusing contractor accountability and responsibility.

Phasing of these contracts to the prime contract will be a key element of our overall transition plan, and final details will be completed after selection of the prime contractor.

A key element of our change process is the evolution and involvement of the Agency's Safety and Mission Assurance Organizations. We recognize that effective training, process control, audit and surveillance are essential to the success of the restructured program.

The S&MA organization will be fully involved in our program changes, and we will continue to depend on their independent assessment of our plans and implementation.

Also, the Aerospace Safety Advisory Panel will be kept fully appraised of our plans and progress to provide an independent assessment relative to program safety.

In summary, we are committed to a restructured program but we will plan and implement the program with safety of flight continuing to be our highest priority.

Thank you for inviting me here today and for your continued support of the human space flight activities and programs. With that, I will be happy to answer any questions.

[The prepared statement of Dr. Little follows:]



National Aeronautics and
Space Administration

Hold for Release Until
Presented by Witness

Sept. 27 1995

Subcommittee on Space and Aeronautics

Committee on Science

House of Representatives

Statement by:
Dr. J. Wayne Little
Associate Administrator
Office of Space Flight

104th Congress

Statement of

Dr. J. Wayne Littles
Associate Administrator
for Space Flight
National Aeronautics and Space Administration

before the

Subcommittee on Space and Aeronautics
Committee on Science
United States House of Representatives

September 27, 1995

Mr. Chairman and Members of the Subcommittee:

I am pleased to present my statement for the record regarding safety as it relates to Space Shuttle program restructuring.

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Considering the maturity of the Shuttle's day-to-day operations, we feel that now is the time for the Government to change its role from supervising or overseeing the routine operations to one of audit and penetration into out of family situations. Each operations task presently being conducted by the government is being reviewed for elimination, continuation, or transition to a contractor.

We will maintain sufficient technical insight into contractor activities to insure independent assessments for safely committing to flight. Also, I have already directed that an improved audit system be implemented across the Space Shuttle program. This new process places emphasis on all aspects of hardware

manufacture and assembly and will improve overall safety. The audit system, coupled with surveillance and detailed technical insight, will provide essential data for our commitment to flight decisions.

Teams are reviewing all documented requirements relative to program operational experience and hardware/software performance. Revised requirements will begin to be implemented within the next few months, but these changes will also be carefully planned and implemented.

In conjunction with the plans for transition of government operations tasks to contractors, a revised streamlined management plan is being developed by the Program Management team. This plan will be a critical part of our transition planning. A key element of our planning is to maintain sufficient technical insight into contractor activities to identify and assess problems. We will also continue to insure technical, schedule, and cost performance by the single prime contractor and subcontractors with our contract fee structure.

We are developing plans for consolidation of Shuttle related contracts and focusing operations aspects of these contracts under a single prime contractor. In making this change, we will improve safety by focusing contractor accountability and responsibility. Phasing of these contracts to the prime contract will be a key element of our overall transition plan and final details will be completed after selection of the prime contractor.

A key element of our change process is the evolution and involvement of the Agency Safety and Mission Assurance (S&MA) organizations. We recognize that effective training, process control, audit, and surveillance are essential to the success of the restructured program. The S&MA organization will be fully involved in our program changes, and we will continue to depend on their independent assessment of our plans and implementation. Also, the Aerospace Safety Advisory Panel will be kept fully apprised of our plans and progress to provide an independent assessment relative to Program safety.

In summary, we are committed to a restructured Program, but we will plan and implement the Program with safety of flight continuing to be our highest priority.

Thank you for inviting me here today and for your continued support of the Human Space Flight activities and programs. With that, I will be happy to answer any questions.

Mr. SENSENBRENNER. Thank you.
Mr. Fragola?

STATEMENT OF JOSEPH R. FRAGOLA, VICE PRESIDENT AND MANAGER OF THE ADVANCED TECHNOLOGY DIVISION, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION, NEW YORK, NEW YORK, ACCOMPANIED BY GASPARE MAGGIO, RISK ANALYST FOR SHUTTLE PRA, AND ERIN COLLINS, RISK ANALYST

Mr. FRAGOLA. Thank you, Mr. Chairman. In the interests of time, I've prepared a written statement that I'd like to have entered into the record.

Mr. SENSENBRENNER. Without objection, so ordered.

Mr. FRAGOLA. And I'd like to summarize just a few points from that written statement if it would be appropriate.

I'm pleased to be here today to speak about a recently completed Space Shuttle probabilistic risk assessment and how it may play a role in keeping safety paramount.

This risk assessment was developed as a direct result of the Rogers and Slay Commissions after Challenger. It was a comprehensive study that took over 18 months.

And as a result of that study, we feel that we have indicated that NASA has achieved a significant launch risk improvement since the Challenger, about a two-thirds reduction.

This also indicated the effectiveness of the design changes that NASA has implemented in the solid rockets, in between flight testing programs, on both the solid rockets and the SSME.

It also pointed out that the planned SSME improvements that NASA has planned for the future are in areas of risk importance.

We think also that this study may provide a basis for NASA monitoring of prime contractor safety performance in this era of transition.

What everyone must understand is that the safest flight is one that never leaves the pad, so zero risk is not an option for space flight, but managing risk between acceptable limits is.

The limits are set not only on what risk is acceptable but also on how certain we are what that acceptable risk might be. The greater the uncertainty, the more the operating limits must be constrained.

This is not a new concept with NASA. It corresponds to NASA's concept of safety margin, that is, the margin above the safety limit that is required to operate.

Early on in programs with high uncertainty, high margin must be available. But later margin can be reduced as experience increases provided that reduction is balanced by reductions in uncertainty.

The risk assessment type of analysis expands the concept of safety margin beyond the traditional areas of structure, space structures to the entire system. And it allows the increased knowledge base with continued operations to understand where margins may be reduced without compromising the level of safety.

Direct NASA implementation of safety oversight then early on, when uncertainty is high, is prudent and it requires the use of large margins. Indirect oversight could produce the same or even

higher levels of safety if the shuttle knowledge base has increased to compensate for the loss margin, especially if safety enhancing design improvements are effective.

The issue then is not whether the conversion from direct involvement to indirect oversight provides adequate safety assurance, given this current shuttle design and this current knowledge base. That's the issue, I think.

Risk assessment might support the resolution of this issue by assessing safety margins and establishing a set of monitoring indicators to ensure that safety level is not eroded by the transition.

Risk assessment provides for a proper weight to be assigned to on-going occurrences or lack thereof, and to anomalies and observed unsatisfactory conditions.

We don't believe that risk assessment is the only answer but we believe that it provides significant input into keeping safety paramount as the shuttle program undergoes future transitions. And with that, Mr. Chairman, I'd like to make myself available for questions.

[The prepared statement of Mr. Fragola follows:]

**TESTIMONY BY JOSEPH R. FRAGOLA
BEFORE U.S. HOUSE OF REPRESENTATIVES SCIENCE COMMITTEE,
SUBCOMMITTEE ON SPACE AND AERONAUTICS**

Genesis of Shuttle PRA:

In the aftermath of the Challenger accident, the Rogers Commission recommended that NASA reconsider quantitative risk assessment approaches and, in fact, by the time the Slay Commission put forth its even more strongly worded suggestions for quantitative assessment initiatives, NASA already had two PRA "Proof-of-Concept" studies underway. These initially limited efforts focused on particular shuttle systems with the objective of indicating potential benefits to be gained from the quantitative approach over the traditional FMEA/CIL process. One study was performed on the Shuttle Auxiliary Power System and its three Auxiliary Power Units (APUs), and the other on the Main Propulsion Pressurization Subsystem (MPPS).

The former study in particular provided initial insight into the power of quantitative approaches by showing that "not all CIL listed items are equal" even though they were theoretically to be treated so; in terms of management and engineering attention each had the potential for leading to a loss of vehicle (LOV). At about the same time, an effort was undertaken under the auspices of the shuttle integration office at JSC in Houston, which became known as the "Shuttle Integrated Risk Assessment". Despite the implication of its name, the study focused initially and primarily on a linked functionality assessment of the Shuttle Main Propulsion System Propellant Management System. Although the thrust varied considerably from a conventional quantitative risk analysis the effort did introduce the PRA concept to a broader segment of NASA and the contractor community.

Soon thereafter the first associate administrator of the recently created Office of Safety, Reliability, and Quality Assurance (Code Q) established a new Safety Division staff position in risk assessment. One of the first assignments of this newly selected individual was to review the risk study submitted by the Galileo program to Interagency Nuclear Safety Review Panel (INSRP) and to recommend that an independent quantitative study be undertaken by NASA Code Q using a PRA approach. This study, when completed, represented the first quantitative assessment of the risk of the total shuttle system. Although it was limited to the ascent portion of the mission, was necessarily top level in nature, and focused primarily upon scenarios which presented a risk to the Galileo nuclear payload, it differed dramatically in kind and in its results from the previous effort undertaken by the payload program office. The study indicated that while the loss of vehicle probability of the shuttle was uncertain, the 90% uncertainty range (based upon all the shuttle flight and test history available at the time, even considering substantial growth in reliability, but keeping the design and operational configuration constant) was between 1/350 and 1/18 missions with a median estimate of 1/78. Code Q released these study results to the press and they were widely quoted. Because of its systematic traceable nature and because its format was familiar to the courts (in dealing with Nuclear Power intervenor suits), the study was used as evidence against a suit brought to delay the Galileo launch. The study's prediction of low public risk despite NASA's forthright admission of possible high shuttle

failure probability convinced the court to deny the intervenor's petition and the launch proceeded on schedule.

Eventually the approach was unanimously endorsed by both the Ulysses program and Code Q for submission to INSRP for this subsequent nuclear powered payload. The study proceeded without fanfare and the launch again was not delayed. Then the approach began to get wider exposure within NASA. It was applied to problems as diverse as wind tunnel design, the assessment of the viability of leak checking the field joint of the proposed Advanced Solid Rocket Motor, the support of the 1990 Space Station design via EVA maintenance, the structure and nature of redesign solutions, and the assessment of the risk of launch delay and other factors on the ability of the current station design to maintain a berthable attitude.

The Deputy Associate Administrator for Space Flight, familiar with PRA techniques from his tenure with the space station redesign team, decided to apply the approach to a comprehensive investigation of space shuttle risk throughout all mission phases from main engine start on lift-off to nose-wheel stop on touchdown. This new study was also to utilize, to the maximum extent possible, not only NASA experience but also contractor experience in an attempt to credit the unique features of the shuttle design and test program as well as the unique insights provided by its reusability. A report on this study, referred to as the Space Shuttle Risk Assessment, has been provided for the Subcommittee's review.

Scope:

The primary objective of this project was to support management and engineering decision-making with respect to the Shuttle program by producing...

- (1) a quantitative probabilistic risk model of the Space Shuttle during flight,
- (2) a quantitative assessment of in-flight safety risk,
- (3) an identification and prioritization of the features of design and operations that principally contribute to in-flight safety risk, and
- (4) a mechanism for risk-based evaluation of proposed modifications to the Shuttle system.

Secondary objectives were to provide a vehicle for introducing and transferring PRA technology to the NASA community, and to demonstrate the value of PRA by applying it beneficially to a real program of great international importance.

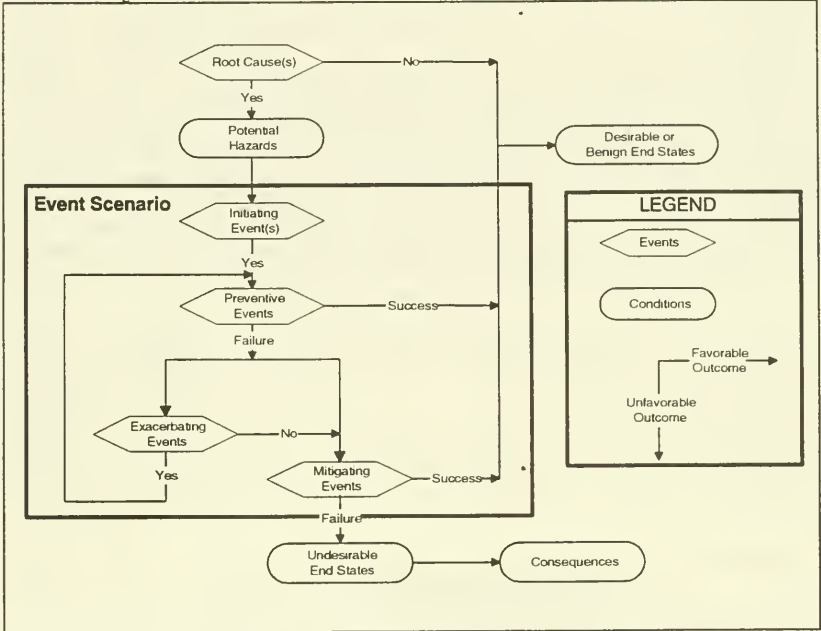
Approach:

The fundamental approach used in this Shuttle risk assessment is that of scenario-based probabilistic risk assessment. The concept of scenarios is basic to any understanding of the PRA process. As the name implies, a scenario is simply the chronological "story" of a sequence of events that is triggered by some incident and proceeds through intervening events to an end state. (In fact, a scenario is often called an "event sequence," and if it deals with an accident, an "accident sequence.")

Figure 1 depicts an accident scenario in the most generic form, including some of the terminology used to describe the elements of scenarios. The key terms are (1) *initiating events* (or trigger events), which — in conjunction with pre-existing potential hazards — begin the scenario; (2) *pivotal events*, which have the potential to change the course of the scenario, and can have preventive, exacerbating, or mitigating effects; and (3) *end states*, which can represent desirable, benign, or unfavorable consequences. In all but the simplest systems, there are several alternative sequences of events that can follow an initiator, depending on the outcomes of the intervening events; each such path is considered a scenario. PRA is simply a systematic technique to evaluate the probabilities and consequences of the various scenarios that can occur in a process or system as well as their associated uncertainties.

The probabilistic risk assessment that is the subject of the report provided to the Subcommittee is the first full-mission risk assessment to be performed on the Shuttle vehicle to date. However, as has been mentioned, NASA and SAIC have conducted a number of previous risk analyses on various aspects of the vehicle and mission. It may be noted that the new results have considerably narrower bounds of uncertainty than the old ones. There are two main reasons for this situation. First, much of the data underlying the current PRA is based on statistical analysis of Shuttle flight and test experience; the additional failure free experience accumulated since the earlier studies necessarily narrows the uncertainty bounds of the risk estimates. Second, the current PRA has analyzed the risk-driving systems in much greater detail than the earlier analyses. In many cases, but not all, a deeper analysis reduces the uncertainty in the results.

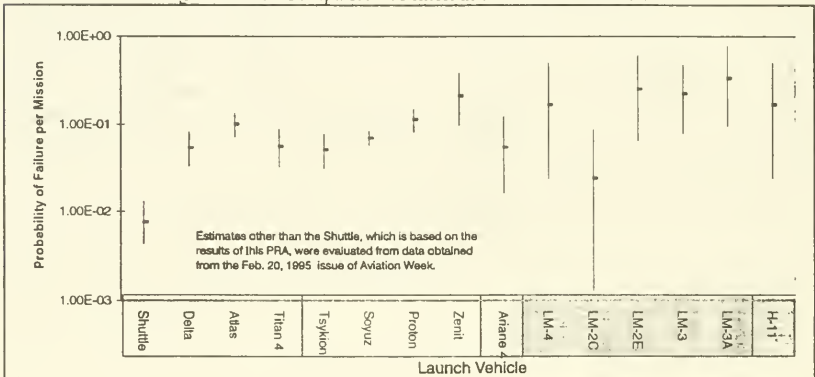
Figure 1 : A Generic Accident Scenario for Probabilistic Risk Assessment



Major Results:

The results of the PRA indicate that the Shuttle has been demonstrated to be by far the most reliable and least risky of all launch vehicles in the world¹ (see Figure 2). However the distinctive advantage of the Shuttle as a returnable and reusable vehicle makes even this comparison fall short of the Shuttle's clear dominate position with respect to other vehicles. Despite this dramatic improvement of the Shuttle over the current inventory of launch vehicles Shuttle LOV risk continues to be substantial. The probability of having a catastrophic failure during a nominal flight was assessed to be, with 90% confidence, between 1 in 76 and 1 in 230 per mission. This implies that if the Shuttle is flown until the year 2030 with an average of 7 missions per year (245 missions), the risk of the occurrence of at least one more catastrophic failure is substantial. Flying the Shuttle until 2015 at the same launch rate corresponds to a 50-50 chance of a catastrophic failure occurring. Note that these risk estimates correspond to the current Shuttle design; changes in design or processing could substantially improve the reliability of certain components thereby reducing the risk to the Shuttle.

Figure 2: Risk Comparison of International Launch Vehicles



The redesign of the solid rocket boosters seems to have significantly reduced the risk due to the failure mode which caused the Challenger accident. However the Integrated Solid Rocket Booster (ISRB) still remains an operationally risky element of the Shuttle vehicle. Although the SAIC team was convinced that the Shuttle booster is the most reliable rocket motor of its type to be built,

¹Whether the Space Shuttle deserves this distinction could be argued. Although the Russian Soyuz had problems early on, it has experienced only three failures in its recent history of over 1000 flights. Therefore, on a recent experience basis, its record would surpass that of the Shuttle. Considering its entire flight history, however, it compares with other conventional launch vehicles.

operating such powerful propulsion systems will always pose a challenge to the safety of a launch vehicle. This is substantiated by the fact that the ISRB risk rate (risk per unit time of operation) continues to be by far the highest of all the Shuttle elements.

The three SSMEs were shown to contribute a significant portion of the Shuttle risk. They account for 37% of the overall Shuttle flight risk even though they are active only during ascent. Practically all of the SSME risk is due to sudden catastrophic structural failure of one of the high energy components (HPOTP, HPFTP and MCC). The redlines which were established to shutdown the engine in the event of off-nominal operation were found to be extremely effective at accomplishing this task. However, an SSME shutdown leads to Shuttle operational conditions which may prove to be even more dangerous than continuing to fire the engine which was to be shutdown. Abort scenarios were not included in this study because of their second order impact. However the results of the study indicate that they should probably be considered in any extension of this study.

The risk of the Orbiter is dominated by failures of two of its main systems, the APU driven hydraulic system and the tiled thermal protection system (TPS). The APU system was found to be susceptible to common cause failures which resulted in multiple APU losses. Although the system was designed to be redundant the propensity for multiple failures negates the advantages of having back-up components. A significant amount of the common cause failures are due to hydrazine leakage. The TPS risk was found to be dominated by certain portions of the tiles which are susceptible to debris generated during separation of the right ISRB. Even though this damage occurs during ascent there is currently no opportunity for inspecting the tiles and repairing damaged ones before they are required during re-entry.

Figure 3 depicts the approximate relative contributions of the principal elements of the Shuttle vehicle to the mean risk of loss of vehicle in pie-chart format.

The "risk drivers" of a system or operation are the factors that dominate the total risk, and consequently should be targeted for further evaluation and potentially for risk-mitigation efforts. The PRA process identifies an event or accident sequence as a risk driver when (1) its occurrence leads to loss of vehicle with little or no chance of recovery, (2) it has a high probability of occurrence, and/or (3) its probability of occurrence or consequence severity are subject to so much uncertainty that it is impossible to say with confidence that it is not a risk driver.

Figure 3 : Distribution of Mean Loss-of-Vehicle Risk Among Shuttle Vehicle Elements.

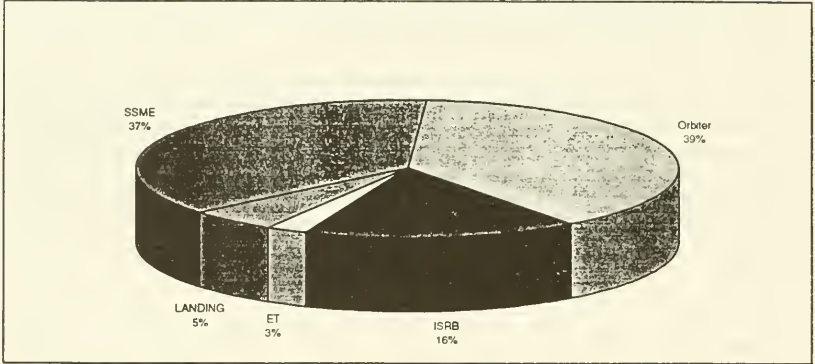


Table 1 summarizes the risk statistics for the most important Shuttle flight risk drivers identified by the base-case risk assessment. (Please refer to *Approach* on page 3 for an explanation of the term "accident sequences.")

Table 1 : Risk Summary Statistics of Most Significant Accident Sequences

Percent of Total Risk	Top 10 Accident Seq.	Top 20 Accident Seq.		Top 10 Accident Seq.	Top 20 Accident Seq.
Orbiter	47.49%	41.98%	Auxiliary Power Units	39.18%	28.99%
			Thermal Protection System	8.31%	12.99%
SSME	45.48%	45.51%	Turbomachinery	37.01%	29.95%
			Combustion Devices	8.47%	15.56%
ISRB	7.03%	12.51%	Redesigned Solid Rocket Motor	7.03%	8.73%
			Solid Rocket Booster	-	3.78%

Strategic Results:

The Space Shuttle PRA not only provided a management tool to assist in making future decisions on safety but also provided quantifiable justification for program decisions made in the past. The PRA has shown that NASA has maintained a proper risk focus by proposing and making significant design modifications to the Space Shuttle, specifically to the solid rocket motor joints (RSRM), main engine turbomachinery (SSME), and orbiter auxiliary power units (APU). These components were shown to constitute approximately 60% of the estimated Shuttle risk. Although the design modifications being made address the major risk contributors as they have been identified in the PRA, the risk reduction effectiveness of the changes must still be verified.

PRA Insights into Keeping Safety Paramount:

From the safety perspective alone, the safest flight is one that never leaves the pad. Operation of any system regardless of the attention paid to safety is never risk free. Therefore, the issue on an operational system never is to operate with zero risk but rather to operate with a risk that is managed or controlled within acceptable limits. However, to do this, the risk being accepted must be known or if not known, the limits of acceptable risk must be reduced to account for this uncertainty. This is not a new concept in the NASA community. It is analogous to the concept of safety margin. It is well accepted that the safety margin may be reduced where the environment is well known and not reduced where it is not. It is also a well accepted concept to require an increased safety margin early in the program and to decrease that safety margin as the program matures and the uncertainty is reduced. Notice that reducing safety margin does not necessarily mean increasing the risk beyond the level considered acceptable, nor the level of risk incurred, as long as the reduction made is balanced by the increase in knowledge of, and experience with, the system and the environment in which it is operated. (In the case of a reusable system, such as the shuttle, the environment also includes the effects of the required processing between uses.)

What the Shuttle PRA does is essentially expand the scope of the safety margin concept beyond the structures area where it has traditionally been applied to the entire vehicle and mission. By addressing uncertainty directly and quantitatively, it allows the determination of the safety margin to be assessed across the entire program in a consistent fashion. For a given level of acceptable risk, it allows for safety margin reductions as the shuttle experience is continually factored into the risk assessment.

Therefore, it might be possible to maintain the same level of acceptable risk, or alternatively, to maintain the same level of safety while reducing margin, as the experience with the shuttle increases. Safety might be kept paramount even as safety margins decrease provided NASA had some mechanism to ensure that the reduction of these margins was consistent with its increased knowledge of the vehicle. From this perspective, it is quite reasonable to expect direct NASA participation in implementing its safety oversight functions early on (when uncertainty is high and where large margins are required), and it is just as reasonable to expect that the same or even higher levels of safety might be maintained later in the program even if direct NASA participation is reduced. This would be possible as knowledge in the shuttle system is increased, especially if this operational

experience leads to (as it has in the case of the shuttle) safety-enhancing design improvements.

The question, therefore, is whether or not the conversion of the NASA oversight from a direct involvement approach to a monitoring and regulation approach provides enough assurance that an acceptable level of safety is maintained at this time given the knowledge and experience base available for the shuttle program. The shuttle PRA might be useful in this regard if it could support the establishment of a level of risk that is considered acceptable, the amount of margin there is above that level given the available shuttle experience base, and whether that margin is unacceptably being eroded by the transfer of the primary responsibilities to a private contractor. Further, if the PRA could support the resolution of these issues, it might provide an objective input for NASA to ensure that contractor cost reduction efforts are consistent with the safety margins supported by the shuttle experience base at the time they are proposed. Additionally, the PRA might provide a method to monitor the safety performance of the shuttle program on an on-going basis to guard against possible unknown adverse downstream impacts on safety caused by previously implemented economies, or by an aging shuttle fleet.

More specifically, the PRA might be applied to the establishment of a set of systematic integrated observable post-flight physical indicators which provide insight into the ongoing level of shuttle risk. These indicators would continually measure the "distance" between the occurrence frequency of post-flight anomalous events and the paths available to actual Loss of Vehicle (LOV). In this way, the anomalous events would act as precursors and early warning signs that the potential for a LOV event may be increasing. For such a set of precursor indicators to be a valid measure of on-going LOV risk, they must be integrated into the LOV risk framework provided by the shuttle PRA. Each event could thus be viewed in terms of steps along the way to a potential vehicle loss and the residual safety margin measured by the risk of progressing from that anomalous condition to an actual vehicle loss.

Establishing such a set of indicators would not be easy. It would require a detailed understanding of all the steps in the shuttle pre-launch process and a further understanding of how anomalous events uncovered during the process would ultimately relate to shuttle mission risk. While the establishment of such a set of risk-based indicators would certainly require a significant extension of the existing risk framework, the current framework is believed to provide a significant step towards the achievement of this goal.

While it is important to allow for a continual learning process from flight and test experience and to take maximum advantage of the reusability of the shuttle, it is also important that this learning be incorporated from a proper risk management perspective. Without a risk basis, a profit-motivated contractor might review the number of anomalies uncovered as time went on. They might then review each investigatory step in shuttle processing in terms of its "efficiency" in detecting or preventing anomalies. One simple measure of efficiency might be how often an anomalous condition is detected. Without a risk-based perspective, there is tendency to say that if anomalies are never detected, then the analogous process step should be eliminated. However, a risk focus sometimes requires relatively rare events, (which progress with high probability to LOV consequences) to be considered even if they have no historical precedent. For those process steps that are directed at the

detection of anomalous conditions, the risk assessment might indicate the retention of these associated detection tasks in areas of risk significance even if no anomalies have as yet been detected.

On the other hand, in those cases where process steps have detected anomalies, the risk level would be measured by embedding these anomalies into the scenarios developed for the PRA thereby consistently weighting them according to their significance as precursors to a LOV event.

Such a system of processing risk management, utilizing the shuttle PRA as a backdrop, might offer direct assistance toward the solution of the shuttle operations cost vs. safety dilemma. Managing shuttle processing in this way maintains in place only those assurance tasks with the highest mitigation cost-effectiveness and might permit shuttle operational experience to be substituted for process step assurance in an orderly fashion, thereby maintaining shuttle flight frequency without risk increases even in the severely constrained budgetary environments of the future. It also might provide a way to assure NASA that the current shuttle safety level is not compromised when shuttle operations are transferred to a private contractor operating under a profit motive.

Potential Applications:

The PRA model developed herein does not represent a complete Shuttle risk model. Nor does SAIC claim it to be. However it is SAIC's belief that the model has been developed to a stage which captures a significant portion of the Shuttle risk. Additional expansions would certainly be worth considering. For example although abort scenarios were identified they were not developed and therefore the associated potential risk can only be roughly estimated. For this reason the model has been developed to be a "living" model which may be modified and amended as deemed necessary to provide risk insights to a variety of management inquiries.

For example the model might be used to establish realistic cost objectives for redesigning the risk driving components. The cost estimates for any proposed design improvement could be tied to exact improvement objectives by risk based criteria. This methodology will assure that limited resources are focused towards solving the problems which will have the most impact on safety.

The model may also be extended and modified to include turnaround processing and maintenance to illustrate the effect on operational risk. Such an analysis would provide a mechanism for ensuring that cutbacks in processing budgets do not significantly influence Shuttle safety. Extensions of this sort would allow processing tasks to be ranked according to their risk reduction worth and the cost incurred to perform the task. In this way management may quickly and concisely compare a task's overall worthiness in meeting future cost constraints and safety objectives.

The current study indicates that it would be useful to consider abort scenarios. The current conservatively estimated probability of their occurrence warrants attention. The risk analysis of abort scenarios differs from the current PRA in that the time at which the initial event occurs is crucial to the criticality of the final consequence. The dynamic nature of this problem further increases the complexity of the analysis process in order to properly represent the true abort risk.

A part of the nominal mission risk, as well as abort risk, originates from landing related processes. Although this study did account for this risk, the associated uncertainty was found to be rather high. This may not be as much of an issue for a nominal flight as it would be for an abort scenario which would require Shuttle pilots and equipment to operate under less tolerant and more strenuous conditions. Therefore a more involved study of the landing process would offer more concise bounds on the related risk and provide insights and set the groundwork for the an analysis of abort scenarios.

In the near future the Shuttle will be utilized in constructing the International Space Station Alpha (ISSA) and will later dock with the ISSA for extended periods of time. These activities introduce processes which differ appreciably from today's nominal orbital operations and in effect introduce associated risks. One of the more obvious risks being the potential for problems during the docking maneuvers which involve two large space structures rendezvousing, precisely maneuvering in close proximity and docking to allow exchange of materials and personnel. Not unlike the propagation of accidents from one Shuttle system to another, attaching two complex systems together for extended periods of time introduces interfacing risks which should be studied and understood. Extensions to the existing study might provide better insight into the nature and magnitude of these risks.

Finally, as the shuttle fleet ages there may come a time that NASA becomes concerned with not just the risk of the shuttle systems, but the basic structure of the reusable portions of the system, especially the orbiter vehicles. Alternatives such as fleet life extension, even though not initially considered, might become viable options as processing costs are reduced and alternatives are limited by economic realities. (The age of the current commercial jet aircraft and the B-52 bomber fleet give witness to this possibility.) In this instance, extensions of the current PRA to include a probabilistic damage tolerance assessment of the shuttle structure might provide evidence of the risk acceptability of proposed fleet life extensions.

- END -

Mr. SENSENBRENNER. Thank you very much, Mr. Fragola. Next is Dr. Paul Johnstone.

STATEMENT OF PAUL M. JOHNSTONE, CHAIRMAN, AEROSPACE SAFETY ADVISORY PANEL, NASA HEADQUARTERS, WASHINGTON, D.C., ACCOMPANIED BY RICHARD BLOMBERG, DEPUTY CHAIRMAN; AND FRANK MANNING, EXECUTIVE DIRECTOR

Mr. JOHNSTONE. The Aerospace Safety Advisory Panel is pleased to be here today to present our thoughts on the shuttle program in transition.

As you say, I am Paul M. Johnstone, I'm Chairman of the Panel, not Director.

And with me today I have Mr. Richard Blomberg, who is Deputy Chairman, and Frank Manning who is our Executive Director.

I might remind you that the panel was established by Congress after the Apollo fire. The basic intent was to create a truly independent oversight committee. We are an advisory panel, as the title explains, and we do not perform inspections or quality assurance functions.

We work very closely with NASA and specifically with Mr. Little on the shuttle program.

The current state of flux and uncertainty in the Space Shuttle program has created a climate in which safety might be compromised. Cutbacks, which result in lost jobs and uncertain futures, both for the program and individual workers, as well as proposed fundamental changes in the structure of the system, have the potential to omit vital steps and undermine morale.

The Aerospace Safety Advisory Panel has responded by increasing our scrutiny of shuttle operations and planning. We have formed three special task teams to examine operations, transition plans, and pressures posed by the flight manifest.

One of these special task teams was at the Kennedy Space Center just last Friday to continue its in-depth review of morale and possible compromises to safety.

I am pleased to report that the commitment of shuttle personnel to safety above all else remains intact. This holds for management and workers and for both contractor and NASA personnel.

To be sure morale is down and distractions are up, but as long as the existence of the program is ensured, professionalism should prevail with resulting safe operations.

It seems abundantly clear that schedules may be sacrificed but safety will not knowingly be compromised.

With respect to the proposed transition plans, we see no inherent reason why any reasonable shuttle structure cannot be consistent with safe operation.

We do, however, believe that the process of change must be approached with full acknowledgement of the extensive legacy represented by over a decade of shuttle operations. The shuttle is neither a new system nor a new organization. It must therefore be changed with care and with a complete awareness that what might work for a totally new corporatization may not be fully applicable to the overhaul of one which has been operating successfully for so

long. We need to use a rifle or a scalpel, not a shotgun or a broad axe.

There are several principles which we believe must be followed in any shuttle program transition process. First, the team approach to shuttle decisionmaking involving both NASA and contractor experts should be maintained. It has functioned effectively and provides the checks and balances which are essential to the operation of such a complex enterprise.

Second, additional reductions in staff and operating functions must be made judiciously by the team itself based on definitive statements of operating objectives and funding guidance from Congress and NASA management.

Those involved in day to day shuttle operations and management are in the best position to determine how to take cuts without unduly impacting safety.

Third, organizational change must be gradual and also managed by the team. Adequate time must be allocated for analyzing the effect of changes as they are made and permitting the system to reach new equilibrium points.

This will ensure that vital safety systems are retained or replaced by suitable substitutes.

In short, we see the Space Shuttle program properly managing risk and in the process of adopting hardware upgrades, such as the Block II main engines, which will provide further safety enhancement.

The program has successfully shed significant costs and can likely reduce expenditures even more without materially increasing risk as long as change is properly managed. Given ample time and guided by those with firsthand knowledge of program operations. With that, we'd be happy to answer any questions that you may have.

[The prepared statement of Dr. Johnstone follows:]

STATEMENT OF
MR. PAUL M. JOHNSTONE
CHAIRMAN, AEROSPACE SAFETY ADVISORY PANEL

before the
Subcommittee on Space and Aeronautics
Committee on Science
United States House of Representatives

Mr. Chairman and Distinguished Members of the Subcommittee:

I am pleased to appear before you today to discuss the status of Space Shuttle safety. I appreciate the opportunity to address the Committee about the Aerospace Safety Advisory Panel's assessment of NASA's commitment to conducting safe Space Shuttle operations. Congress enacted legislation in the aftermath of the Apollo Command and Service Module fire establishing our Panel as an independent safety advisory committee to NASA. In carrying out its statutory duties, the Panel gives priority to those programs that involve the safety of human flight (both aeronautics and space). We conduct fact-finding sessions using small groups from the Panel to explore areas within their expertise. The Panel's activities provide an opportunity for both NASA and contractor management and "hands-on" personnel to reexamine their functional responsibilities. The Panel does not perform any of the safety, reliability and quality assurance functions of NASA or its many contractors, nor does it interfere with their day-to-day activities. The Panel does, however, provide independent, objective assessments and advice, with emphasis on safety, that is not obtainable in any other way.

The Challenger accident brought into sharp focus the risks involved in human space flight and the importance of safety. A significant number of recommendations associated with improving safety were implemented by NASA and its contractors following the accident. Many of these involved more comprehensive policies, procedures and inspections. The revised approach required a considerable increase in work force to support Space Shuttle missions.

In the current climate of reduced budgets and after almost a decade of safe operating experience under this new regimen, NASA's must streamline its operation without compromising safety. One method to accomplish this is to empower the technician performing the work with the direct responsibility for the quality of the work he or she performs. Unnecessary inspections and duplication of effort are thereby eliminated, especially where another inspection occurs later in the work process. This can provide for greater efficiency, increase the pride of ownership among technicians and reduce personnel requirements.

The Panel believes it is imperative that NASA maintain a high level of safety consciousness in all its activities. Safety functions cannot be allowed to become "routine." The safety organization must maintain its independence if it is to function effectively. It is vital that NASA management continues its dedication to risk reduction and risk management if NASA's research and exploration programs are to be successful.

There is the distinct possibility that over-zealous reductions in the work force and NASA budgets, while at the same time retaining tight schedule pressures, may introduce increased levels of risk and jeopardize Space Shuttle safety. NASA cannot continue to launch Space Shuttles back-to-back and compress schedules while at the same time reducing its work force to a bare minimum. The flexibility to absorb unexpected launch delays may be lost. As a result of the NASA

Administration's and Panel's concerns, we have created three task teams from the Panel to monitor and assess the Space Shuttle Program during the critical restructuring period. One team is charged with reviewing the operations at the Kennedy Space Center (KSC) and taking the "pulse" of the work force. This team was at KSC last Friday and spoke with technicians and management. The personnel at KSC are as dedicated as ever, but the constant stress, pressures and uncertainties are leading to a lowering of morale.

The second team is looking at the impact of reduced budgets and tighter schedules on the ability of the Space Shuttle to support the assembly and operation of the International Space Station. The third team is assessing the potential safety impacts from NASA restructuring and the transition of the Space Shuttle Program to a single prime contractor.

While it is still too early to assess the implications of program restructuring including adopting a single prime contractor, there are some factors which must be considered:

1. Already implemented reorganizations and reductions in the work force have led to unrest and uncertainty among the NASA and contractor personnel. There is a real danger that further significant reductions, unless carefully planned and implemented by operating management, can lead to severe problems. It is impossible to define clearly at what point the Program will cross over from safe to unsafe conditions, but this crossover will surely occur if such a process were allowed to proceed uncontrolled.

2. Since the Challenger accident, the surfacing and resolution of problems and issues within the Program has been exemplary. In order to continue safe operations, the ability to surface mistakes and errors without retribution must be maintained. In any organization, there is some tendency to avoid acknowledging errors in order to "save face." This has not been the case in the

Space Shuttle Program. This is attributable to the current system of "checks and balances" between the contractors and the NASA employees responsible for oversight functions. Deletion or weakening of this cross-checking can adversely affect Shuttle safety.

3. As the Shuttle fleet ages, the amount of unplanned Space Shuttle processing work will continue to grow. Maintenance and replacement of components and systems will become increasingly difficult. In some cases, Space Shuttle systems will need to be redesigned because the components are no longer manufactured and cannot be repaired. In other instances, the Space Shuttle systems or processes are forced to be modified as a result of federal and/or local government environmental laws and regulations. Lack of spares or the unavailability of system components will lead to logistics problems and the increased likelihood of "cannibalization" of parts and components in order to support launch schedules.

4. In March of this year, Endeavour was launched missing some washers. Experienced workers had certified that the washers had been installed on four bolts when they had not. Complacency is a possible contributing factor to this incident, but the added stress caused by talk of Shuttle "privatization," possible government shutdown, personnel furloughs and NASA restructuring may have played a role. Such distractions are inevitable as long as these issues remain unresolved.

5. The Space Shuttle will always be a developmental vehicle. As such, there is no substitute for the experience of personnel who have been with the program for a considerable time. Safety cannot be maintained unless a reasonable cadre of these knowledgeable people remains with the Program.

As a result of re-inventing government and budget cutting exercises underway, all federal agencies are going through downsizing and reorganization. The NASA Administrator, Mr. Dan Goldin, has the difficult task of developing plans to accomplish these goals while still maintaining safe Space Shuttle operations. The Shuttle program has recognized the need to economize and has made numerous changes to streamline processing and operations. To date safety has not been adversely affected because down-sizing and streamlining efforts have been accomplished prudently. In fact, the implementation of safety improvements currently in development, such as the Block II Main Engines, should result in even safer Space Shuttle Operations.

One immediate impact of lessened resources has been a reduction in the number of Shuttle flights per year from eight to seven. With the importance of the joint U.S./Russian missions and the beginning of the Space Station assembly process, however, this does not necessarily relieve any pressure on the schedule. We continue to believe that NASA must maintain a philosophy of "Safety First, Schedule Second." If it does, and NASA approaches planned reductions with care, a successful transition to a single prime contractor for Shuttle operations can be safely accomplished if no less than three to five years are allocated to the process. Nevertheless, NASA must continue to maintain full authority and responsibility for the readiness of the Space Shuttle to proceed to launch if safe operations are to continue.

This concludes my prepared statement. I would be pleased to answer any questions or discuss any matters that may be of interest to the members of the Subcommittee.

Mr. SENSENBRENNER. Next up is Dr. Hans Mark of the University of Texas at Austin.

Dr. Mark?

STATEMENT OF DR. HANS MARK, DEPARTMENT OF AEROSPACE ENGINEERING AND ENGINEERING MECHANICS, THE UNIVERSITY OF TEXAS AT AUSTIN

Dr. MARK. Mr. Chairman, it's a pleasure and honor for me to be here today to participate in this hearing, the importance of which I need only note, because both Chairman Walker and former Chairman Brown are here to listen to us, and to deal with this important subject of how you operate safely this vehicle that we've called the Space Shuttle. I have a written statement which I've submitted for the record, sir, and—

Mr. SENSENBRENNER. Without objection, it will be included.

Dr. MARK. Let me just summarize it orally very, very briefly. I think that in the past 30 years, I've had considerable experience in the safety of flight business. I spent eight years as Director of the NASA-Ames Research Center in California. We had about 20 airplanes assigned to us during those eight years, and we had, during the—with thousands of flying hours, had only really one accident that was caused by lack of training of a ground controller. I was on the Apollo 13 Accident Investigation Board.

And most recently, I've been a member of a Blue Ribbon Panel that the Air Force has established to look at its safety of flight.

I've got a couple of copies of the Blue Ribbon Panel Report here for the Committee, which I will leave with you. And I'll come back to this in a minute because I think some of the things we've found are relevant to the questions that have been raised.

I really have very little to add to what Dr. Johnstone has already said. There are certain principles that need to be heeded in such a transition. One of them is that safety is a line management function. It is not something that you can delegate to an organization and say, well you guys take care of it. It is something that everybody in the line management has to heed, has to be personally responsible for.

To give you an example, the way we had the thing organized at Ames, the safety officer of our Flight Operations Branch was one of the test pilots. It was not somebody whose job was safety. It was the test pilot's job, the safety officer's job, who was also a test pilot, to see to it that the rules and regulations that we promulgated were actually enforced.

In the Air Force, the same thing happens. Every squadron has a safety officer who is an active pilot. Every Wing has a flight safety officer who is an active pilot doing that job for a year, and then goes back to the business of flying. And so embedding safety in the management is I think of primary importance.

That this works in the Air Force is illustrated in a chart that I left in my written statement. The accident rate today is one-third of what it was 20 years ago. Even though we have problems, the accident rate has gone down since 1975 by a factor of three. And it is because this principle is heeded.

The second principle is this. Accidents are most often caused by human failure. Very few accidents are now the result of unantici-

pated equipment problems. Most of the time, it happens that someone doesn't follow procedures, something is left out, and you've all heard these stories. Two things follow from that.

One is that training, training for safety becomes very important. The Air Force, for instance, runs training programs for Wing Safety Officers. The Air Force Safety Agency does an excellent job doing that, and this is something that I think in this transition, one ought to pick up and look at the training of people to deal with safety problems, problems that are clearly going to affect safety.

The second one has already been mentioned. It has to do with morale. Morale is an intangible and yet you know it when you see it. One of the things we've found out in our review of the Air Force Safety Program led to a recommendation we made in our report that I want to read to you because I think it bears on the situation here. The Air Force is downsizing, as is NASA. That's the order of the day.

Our twelfth recommendation is to review the safety impact of reduced manning and reduced aircraft numbers, while there has been no change in operational requirements.

And that is happening in the Air Force today, and that is why we are concerned about it, and why we made this recommendation.

I think when you do such a transition, you need to do it in such a way that you don't overload people, that you don't make it impossible for them to do their jobs on reasonable time scales.

It is terribly important for the management to be honest, for the management to tell people what's happening as soon as possible, for the management to see to it that when the contract is implemented, experienced and talented people are retained.

I've gone through a number of contractor operations myself of turning things over to contractors. Those are the things that must be watched.

One final point. Inevitably, some people are going to be unhappy about the change, and therefore it is also important to make sure that security measures are taken to prevent possible sabotage. I don't want to put too much emphasis on this but that is always a possibility and we need to be careful about that. There is simply too much at stake.

Mr. Chairman, that's the completion of my statement. I'd be happy to answer any questions.

[The prepared statement of Dr. Mark follows:]

Testimony Delivered Before The Space Subcommittee of the Committee on
Science, Space and Technology, United States House of Representatives

Hans Mark

September 27, 1995

Mr. Chairman and members of the Subcommittee. It is a pleasure and an honor for me to appear before you. My name is Hans Mark and I am a Professor of Aerospace Engineering and Engineering Mechanics at The University of Texas at Austin. From 1969 to 1977, I served as director of the NASA-Ames Research Center and from 1981 and 1984, I was the Deputy Administrator of NASA. During my service in NASA, I was directly involved first in the development of the space shuttle and later in its operation. I am therefore quite familiar with all aspects of the space shuttle system and its management.

In the past thirty years, I have also been involved in issues related to safety of flight of both aircraft and spacecraft a number of times. During the years that I headed the NASA-Ames Research Center more than twenty aircraft were assigned to the Center. Some of these were experimental aircraft and others were conventional ones operated for research purposes. We therefore had to be seriously concerned about safety of flight. In 1970, I served as a member of the Investigation Board that was established to explain what happened to the Apollo 13 mission. Most recently, I served as a member of the Blue Ribbon Panel established by the Air Force to look at flight safety procedures. An executive summary of the report and our recommendations are attached. This report was delivered to the Chief of Staff of the Air Force on September 5, 1995.

On March 16, 1995, I appeared before this committee to testify on the organization of the space shuttle program and how the vehicles should be operated. In my statement I supported the plan NASA is now developing to turn the operation of the space shuttle over to a prime contractor. I have been arguing that this should be done for more than a decade and I am very pleased that NASA is finally doing the right thing. Last March I said that the risks inherent in the management change that NASA is proposing can be dealt with in a appropriate manner. My purpose today is to outline some principles that, I believe must be

heeded to turn over the operation of the space shuttle to a single prime contractor in a safe and effective manner.

The first principle is that any organization that operates aircraft or spacecraft must recognize that safety is a line management function. It is not something that should be delegated to a separate organization. Rather the rules established and the measures taken that insure safety of flight must be part and parcel of the functioning of the organization. Let me give you two examples: At the NASA-Ames Research Center, there is a Flight Operations Branch responsible for operating the Center's aircraft. The Branch has a safety officer who is one of the active pilots and it is his job to see to it that the safety regulations we had established were followed. A similar system exists in the Air Force. Each squadron has a safety officer who is an active pilot in that squadron. Each wing has a safety officer who works full time on safety but who was assigned from an active flying position to the safety post and who will return to flight status once the tour as safety officer is completed. That this system works well is best illustrated by the results. In my eight years at Ames during which our airplanes flew thousands of hours, we had a single accident, a midair collision caused by lack of training of a Navy air traffic controller at Moffett Field. The Air Force also has an excellent flight safety record. This is illustrated in Figure 1 which shows the accident rate per 100,000 flying hours for the past twenty years. There has been substantial improvement since 1975, the overall accident rate in 1995 being less than half of what it was twenty years earlier.

In view of this, my first recommendation is that NASA must insist that the safety function be tightly embedded in the line management organization of the contractor chosen to operate the space shuttle.

A second principle can be drawn from the recognition that today most aircraft accidents are caused by the failure of people to follow the rules. These "human" or "pilot" errors have dominated aircraft accident rates for a number of years. It follows therefore that appropriate and detailed safety training for all people involved in the operation of the space shuttle must be provided. NASA must insist that the contractor selected to operate the space shuttle establish comprehensive safety training programs for all people associated with the operational aspect of the contract. The training system operated by the Air Force Safety Agency (AFSA) may be a good model for the contractor.

In addition to training, morale is also a very important consideration. Personnel reductions in the federal government are the order of the day. Both the Administration and the Congress are committed to reducing the size of the government and NASA must be very careful to make certain that personnel reductions and personnel changes do not adversely affect safety of flight. The Air Force is also managing personnel reductions and the Blue Ribbon panel found grounds for concern that safety may be compromised. Unfortunately, in the Air Force, personnel reductions have not been accompanied by reductions in requirements. There is some evidence, in fact, that the Air Force is now being asked to do more with less and the Panel concluded that this may eventually affect safety of flight. It is for this reason that the Blue Ribbon panel made the recommendation that the Air Force "Review the safety impact of reduced manning and aircraft numbers while there has been no change in the operational requirements."

In making the transition to a contractor operated space shuttle, NASA must make certain that adequate manpower is available to sustain the planned flight rate. I have carefully studied NASA's plan for the transition to contractor operations and I have discussed the matter with NASA people in leading positions. One of the objectives of making the transition to a contractor operation is to "Reduce Operations Costs". Ultimately, this objective can only be achieved by making manpower reductions. These have to be very carefully managed in order to make certain that safety of flight is preserved and ultimately enhanced.

I have two recommendations about personnel policies that should be implemented in the transition that will help to maintain safety of flight. There are now a great many people both on the civil service payroll and in the employ of the several contractors now operating the space shuttle, who are both very experienced and highly competent. It is important to identify these people early on and to make certain that the prime contractor eventually selected to operate the space shuttle hire as many of these people as possible. The most important factor that causes low morale is the fear of unemployment. Therefore, guaranteeing continued employment is the best way to prevent low morale. Having been involved in several contractor transitions during my years working for NASA, I know that what I have recommended here can be done if the management pays proper attention to the problem.

My second recommendation is that NASA must enhance inspection and security measures at the Kennedy Space Center during the transition. While negative effects on

morale can be mitigated by the steps I have already suggested, it is inevitable that some people may become very upset by the proposed changes. Thus, sabotage cannot be ruled out. It only takes one person to do incalculable damage to an operation such as the space shuttle. Therefore, I recommend that security and inspection activities should be substantially enhanced during the transition process.

Mr. Chairman and members of the Subcommittee, let me conclude by saying once again that I am strongly in favor on making the transition of the space shuttle operation from the current management structure to a single operational contractor. I believe that if the proper steps are taken, this transition can be managed without compromising the safety of flight.

Mr. Chairman, this concludes my testimony. I would be pleased to answer any questions.

USAF Class A Mishap Rates

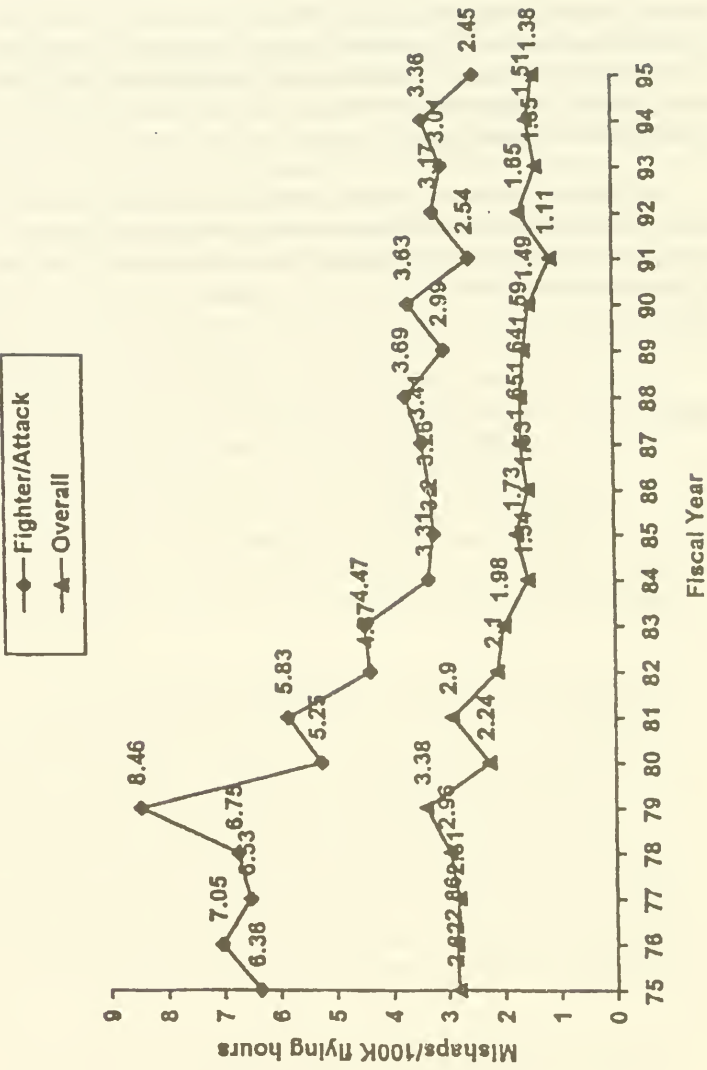


Figure 1



THE BLUE RIBBON PANEL ON AVIATION SAFETY

5 September 1995

**REPORT
OF THE
BLUE RIBBON PANEL ON AIR FORCE SAFETY**

- Chairman:** Vice Admiral Donald D. Engen, U.S. Navy (Ret.)
Former Administrator of the Federal Aviation Administration
- Member:** General Robert C. Oaks, U.S. Air Force (Ret.)
Former Commander U.S. Air Forces in Europe
- Member:** Professor Hans Mark
Former Secretary of The Air Force
- Member:** Brigadier General Joel T. Hall, U.S. Air Force (Ret.)
Former Commander of The Air Force Safety Agency

BLUE RIBBON PANEL REPORT
EXECUTIVE SUMMARY

The Chief of Staff of the Air Force convened the Blue Ribbon Panel to review aviation safety in the Air Force. The Terms of Reference broadly defined the scope of the review and gave the Panel authority to examine Air Force safety organizations and procedures without restriction. Further, the Panel was empowered to look at all safety documents and to talk with any and all Air Force personnel relevant to the Panel's mission. Specific attention was directed to mishaps that cause loss of life or destruction of an aircraft.

The Panel developed a questionnaire to which over 600 Air Force people responded and also visited twenty Air Force organizations (Major Commands, Numbered Air Force, Wings, and Squadrons) with operational missions. The Panel also reviewed Air Force safety organizations and staffs.

The Panel conducted a thorough review of the Air Force safety philosophy, the use of privileged information in mishap investigations, safety organization and staffing, the availability of adequate resources, human factors and other safety related matters.

Two major conclusions emerged from this review.

1) The organizational structure of the Air Force Safety effort - both in the prevention and in the investigation of mishaps - is appropriate for a military organization. Combat efficiency must have first priority for the Air Force and this means that the responsibility for flight safety must be lodged in the military command structure.

2) The Safety Investigation Board process must be strengthened to ensure that the report of the Board reflects precisely the results of the investigation and can not be changed by the people in the chain of command. It is the strongly held view of the panel that the integrity of the process depends upon the independence of the SIB and an open Command endorsement process.

The Panel would like to express sincere thanks to all those in the Air Force who assisted the panel in this review.

4.0 RECOMMENDATIONS

This summarizes the recommendations made in the report. The panel recommends the Air Force:

- 1) Continue to vigorously protect privileged information as applied to the SIB process.
- 2) Combine and collocate AF/SE and AFSA.
- 3) Consider making AFSA/CC a Major General.
- 4) Provide means and accountability for insuring human factors integration into the acquisition of new weapon systems.
- 5) Establish a centralized Air Staff responsibility for the integration of the CRM program.
- 6) Make mandatory AFSA training courses for SIB Presidents and Members.
- 7) Update AFI 91-204 which defines Class A Mishaps to:
 - (a) reflect 1990's aircraft cost data
 - (b) redefines Mishap classification criteria
- 8) Require the SIB report reflect precisely the results of the investigation to preserve the integrity of the process.
- 9) Designate the MAJCOM Commander as the Class A mishap SIB convening authority.
- 10) Require an experienced AFSA representative to serve as a voting member on each Class A SIB.
- 11) Establish a comment and endorsement process for those in the chain of command above the squadron or wing level.
- 12) Review the safety impact of reduced manning and aircraft numbers while there has been no change in the operational requirements.

Mr. SENSENBRENNER. Thank you very much, Dr. Mark. There is a vote on the floor and at the beginning of the hearing, the Chair neglected to seek authority to declare recesses.

There's now a necessity for the Chair to declare a recess, so I ask unanimous consent that I be given authority to declare a recess, which I intend to do right now. Is there objection?

[No response.]

Mr. SENSENBRENNER. And if not, the subcommittee is in recess for ten minutes.

[Recess.]

Mr. SENSENBRENNER. The subcommittee will be in order. It is now my honor to recognize General Stafford to proceed.

**STATEMENT OF LIEUTENANT GENERAL TOM STAFFORD,
STAFFORD, BURKE, AND HECKER, 10006 CAMERON STREET,
ALEXANDRIA, VIRGINIA**

Lt. General STAFFORD. Mr. Chairman, members of the subcommittee, I'm pleased to be here with you today to discuss my experiences and views and how they relate to the issues of the Space Shuttle program, particularly restructuring, streamlining and safety.

And, Mr. Chairman, since 1980, I've become increasingly involved in private industry, serving primarily as a member on the boards of directors. Presently I serve on the board of nine publicly listed firms plus two private firms.

And I have observed and been deeply involved in the major restructuring and streamlining of these industrial firms become competitive in the world marketplace.

And today, many of the United States' industrial firms are the most competitive in the world. And in many of the market segments, they are producing a quality product with far fewer managers, supervisors, and workers than was ever imagined 15 years ago.

The private sector industrial restructuring over these past 15 years has involved management, the research and development processes and production techniques, has shown that numerous layers of management and supervision can actually detract from producing a quality product in a timely fashion.

A similar conclusion can be made with respect to many of NASA's operations, including the Space Shuttle program and restructuring that is presently in process.

There's always a critical criteria on how to transition from the present mode of operation into a streamlined, more productive mode, while still maintaining a required level of safety.

And this afternoon, Dr. Little has described that he is developing a transition plan that will address this issue. I know he's being ably assisted by Mr. David Mowberly of the Marshall Space Flight Center, who has worked for me on several committees that I have chaired, and I can assure you that he'll do an absolutely superb job in that transition.

In reviewing history concerning military aircraft for safe operations, the Air Force determined in the early 1960s that more wear and tear was being done to the aircraft by pulling them apart for

inspections every one hundred hours than damage incurred just in normal flight operations.

And today, all three military services perform maintenance based on cycles and a time-part replacement criteria.

The airline industry has certainly perfected these techniques and has a superb safety record.

And lessons learned from both the military aircraft operations and maintenance should be very valid in this streamlining effort.

Last year, the Administration directed a major Federal Laboratory review and I chaired the Committee for Human Space Flight area. That included Johnson, Marshall, Kennedy and Stennis.

In the research and development area that we reviewed, we found that the manager to engineer ratio varied from 3.2 to 3.7 to one.

And correspondingly, in the private sector, for these functions is typically ten or twelve to one, and it can go as high as 15 to one.

And Mr. Goldin has set forth a goal of ten to one, and that is in the budget that you've seen presented to you. While only a small portion of the Space Shuttle involves research and development, some of these restructuring efforts in the ratios going higher I feel will not have a major impact on safety.

In closing, I'll reiterate that reduced layers of management and supervision, and empowering the technicians, if done properly, will not reduce safety of operations, and it will carry out the goal of streamlining the Space Shuttle program.

There will always be risk in human space flight, and I have certainly encountered a few of those in my four flights that I flew.

I am convinced that the current NASA management has the ability to carry out the task that is put before it.

And thank you for the opportunity to make my brief statement here this afternoon, Mr. Chairman. And I'd be happy to answer any questions.

Mr. SENSENBRENNER. Thank you very much, General Stafford.

And thank you again, to the other members of the panel, which I think is most enlightening and certainly crystallizes where the issues are.

I understand we are going to be having another vote on the floor relatively promptly, but I think, because the bell has not rung, I will yield myself five minutes and recognize myself for questions first, and then as other members show up, either before the vote or after the vote, they will be recognized as well.

Dr. Littles, I'll be very candid and honest with you.

[Bell rings.]

Mr. SENSENBRENNER. And we will now recess, and I'll be candid and honest after the recess, just as I would have been had the bell not rung.

[Laughter.]

[Recess.]

Mr. SENSENBRENNER. The subcommittee will be in order. The members, panelists, and guests will please take their seats.

I am informed by the folks on the floor that we will have enough peace and quiet to finish this hearing without further interruption, so I would like to apologize for our unseemly exits the last two

times. I don't think it will happen again today. I yield myself five minutes.

Dr. Littles, I think that the page and a half worth of testimony that you have given on a very serious subject is woefully inadequate. It doesn't answer the serious questions that this panel has, and I think the public and NASA employees have, about how all of this downsizing is affecting shuttle safety, not only after we go to the single prime contractor, but during the period of transition from the present arrangement to the single prime contractor.

The other witnesses on this panel today, and specifically Dr. Mark and Mr. Johnstone, have talked about specific concerns that they have relative to what will be going on to ensure the shuttle's safety from now through the time the transition to a single prime contractor occurs.

Your testimony answers none of this. This is more something that could be written by the public relations department over at NASA than testimony to your Oversight Subcommittee on a very, very serious subject.

Now, I had not planned to have a second hearing on this subject but because NASA has decided to be so unspecific relative to these concerns, I am going to have a second hearing on this subject, and you and the other folks from NASA will be invited to testify, responding specifically to the concerns that Mr. Johnstone, Dr. Mark, and Mr. Fragola have made relative to the transition to a single prime contractor.

Now, as you and most of the other people in this room know, I have been one who has been very strongly opposed to congressional micromanaging of agencies of the Federal Government.

I will be very honest with you, Mr. Littles. This type of statement with its lack of specificity in answering the concerns that have been raised on this subject is one of the things that invites congressional micromanagement.

And so that we don't get into this, I'm going to give you an opportunity some time within the next month or six weeks or so to be much more specific in responding to these subjects.

But you may rest assured that we're going to have a second hearing on this subject before this Congress adjourns, and hopefully that will happen before Thanksgiving. I yield back the balance of my time. The gentleman from Texas, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman. Mr. Littles, at the time that the budget resolution came out, NASA issued a statement on the impact of the cuts that it contained, and, Mr. Chairman, I'd like to ask unanimous consent to enter the NASA statement into the record.

Mr. SENSENBRENNER. Without objection.

[The material follows:]

PRESIDENT'S \$5B REINVENTION EFFORT FOR NASA
ACHIEVABLE AND RESPONSIBLE

FY 1996 CONGRESSIONAL BUDGET RESOLUTION REDUCTIONS EXCESSIVE

Since 1993, NASA has reduced its five-year budget plan by 30% by rescoping programs, eliminating low-priority efforts, reducing support contracts and conducting two employee buyouts--saving the American taxpayer nearly \$40B. The President's FY 1996 budget plan for NASA calls for an additional challenge to reduce Agency spending by \$5B through FY 2000.

The President's 10-year balanced budget plan maintains NASA's FY 1996-FY 2000 budget at levels proposed in February 1995, and maintains the NASA budget from FY 2001-FY 2005 at approximately \$13B in outlays annually, while making room for increases for fundamental scientific research. The President's 10-year plan reinforces the Administration's view that NASA research, development and technology investments represent a critical investment in the Nation's current and future competitiveness.

Responding to the President's challenge, NASA conducted a six-month, intensive Zero Base Review, and has successfully identified \$5B in savings to be achieved through sweeping management and organizational changes over the next five years. While program efficiencies are achieved, none of the content of NASA's critical core programs in science and exploration is eliminated to achieve the reductions. The Zero Base reductions are to be accomplished in several categories:

- o Efficiencies
- o Restructuring
- o Privatization
- o Commercialization
- o Outsourcing
- o Deregulation
- o Performance-based contracting

The Zero Base Review preserves NASA's major installations, defining roles and missions specific to each installation in accomplishing NASA's strategic enterprises--Mission to Planet Earth, Aeronautics, Human Exploration and Development of Space, Space Science and Space Technology. NASA's reinvention efforts are estimated to result in a workforce reduction of 25,000-30,000 over the next five years, bringing the total 1993-2000 job loss under the current NASA plan to approximately 55,000. NASA's reinvention objective is to produce a leaner, more efficient Agency while preserving NASA's heritage of excellence in research and development and delivery of benefits to the Nation.

The FY 1996 Congressional Budget Resolution mandates a significantly higher NASA five-year reduction--totalling approximately \$8.2B--which would cripple major elements of the NASA institution and truncate the investment in future U.S. competitiveness in aerospace technology. Among the specific reductions beyond the President's \$5B reduction assumed by Congress are major cuts in the Mission to Planet Earth, Space Shuttle and Aeronautics Programs. These Congressional reductions beyond the \$5B savings already planned by NASA should not be implemented:

- o NASA has already significantly descope~~d~~ its plan for the Mission to Planet Earth Program and is incorporating advanced technology into the second generation of Earth-observing spacecraft, which will achieve major cost reductions in the second generation of Earth-observing spacecraft after FY 2000.
- o NASA's Zero-Base streamlining efforts already envision structural consolidation of Space Shuttle activities into a single prime contract which will yield substantial savings while still ensuring its safe and efficient operation. Further reductions in the Shuttle Program prior to stabilisation of experience under a single contractor would be unwise.
- o NASA's cutting-edge research and development in aeronautics has forged partnerships with U.S. industry leveraging total National resources to advanced an aeronautics industry which contributes one million high-quality jobs to the U.S. economy and \$20-30B in U.S. aerospace exports annually. It is critical to preserve the U.S. ability to compete for the post-2001 aircraft market which could produce \$250B in sales and 150,000 jobs.

Funding reductions assumed in the FY 1996 Congressional Budget Resolution are estimated to result total U.S. aerospace job losses approaching 70,000 and threaten severe contraction or closure of NASA field installations engaged in science and aeronautics. The reductions envisioned in the FY 1996 Congressional Budget Resolution go too far; in the process to achieve budget reductions, the Resolution threatens fundamental dislocation in United States investment in research and technology, the key to the economic prosperity and security of future generations of Americans.

NASA's plan for five-year reductions totalling \$5B will achieve changes which are both responsible and prudent, and can be implemented in a effective manner.

Mr. HALL. And with respect to the shuttle, NASA stated, quote. NASA's zero-based streamlining efforts already envision structural consolidation of Space Shuttle activities into a single prime contract which will yield substantial savings while still ensuring its safe and efficient operation.

Further reductions in the shuttle program prior to stabilization of experience under a single contractor would be unwise. Is it fair to say that you agree with that statement?

Dr. LITTLES. Yes, I do agree with that statement.

Mr. HALL. And how long, Dr. Littles, would it take to conduct a competition for a shuttle prime contractor and to sign a contract?

Dr. LITTLES. Our schedule right now calls for us to complete that activity about this time next year.

Mr. HALL. There are folks who disagree with that, though, are there not?

Dr. LITTLES. I don't know anyone who disagrees with the schedule for selecting the prime. There's some disagreement, I think, about the transition process.

Mr. HALL. Okay, well maybe that's what. Mr. Johnstone, the Chairman of the Aerospace Safety Advisory Panel, has testified he believes it'll take no less than three to five years for a safe and successful transition.

Dr. LITTLES. Yes, sir.

Mr. HALL. And you agree with that, to a single, to a shuttle prime contractor? Would you agree with that estimate?

Dr. LITTLES. When we made our presentation to industry, we presented what we anticipated to be the transition period. It will vary for various parts of the program.

We think bringing the prime contractor on and transferring those tasks, operations tasks which will be transferred to that prime contractor, will take between one and two years after he comes on board.

There are other parts of the program which would eventually be transition, and some of those are production activities that could stretch out to five years, yes, sir.

Mr. HALL. So I think you heard my opening statement where I quoted Bob Crippen, former director of the Kennedy Space Center, express his concerns in a December 1994 interview with Space News, and to refresh your memory, I'll quote some of that again.

"While additional cost reductions can be implemented without affecting flight safety, the rate at which it's coming out has me concerned."

That's Crippen's statement. He said, "I've expressed these concerns to upper level management. The whole system, as I see it, both external to the agency and internal, is to try to drive the cost down, he said. It's just got to the point where I'm not very comfortable with it anymore."

I think it should be noted that Mr. Crippen voiced that concern even before additional cuts were proposed by the Administration and by the leadership in the budget resolution. How would you respond to that, sir?

Dr. LITTLES. We're going to do nothing in taking cuts in this program to compromise safety.

Our priorities in this program are safety number one, meeting the manifest number two, and then cost reductions.

The program's been very successful over the last three or four years in making reductions. As a matter of fact, about a year ago, a year-and-a-half ago, there was some concern that reductions may have been taken too quickly.

At that point in time, we formed independent teams and reviewed the total work force in the program from bottom to top, every task, and assessed all the work that was being done. We tasked that team with ensuring that we had not taken cuts that would compromise safety.

The independent teams worked with the projects, the NASA projects, and with the contractors, and concluded that we had not taken cuts at that point in time to compromise safety.

We're using that review as a baseline and any changes that we make in the program going through this restructuring will be looked at very carefully to make sure that we don't delete some activity and delete some task that compromises safety.

Mr. HALL. Well, I think it's a general statement that all of us would make that we don't want to compromise safety.

Understand the position we come from in that we have to lay it on the line here to vote the appropriations and to set forth the substance that you used to carry out a program that you're assigned to carry out.

And frankly, during the 15 years that I've been here, I've sat here and felt a lot of times like they were hammering me with safety when they really had some places and some fat they could have cut out. I can't accuse Mr. Goldin and those who support him and back him up on that because of the cuts that he's led the way in taking since '92 or '93.

But it kind of gives me a lot of concern where a guy like Bob Crippen, who to me is the heart and soul of the space thrust, to say it's just got to the point where I'm not very comfortable with it anymore.

What effect does that have on personnel, those who were widely quoted in many articles, what effect does that have on the folks with whom you work?

Dr. LITTLES. Well, I don't believe Bob Crippen left this Agency because of his concern with the safety of this program.

Mr. HALL. Not totally, but he certainly expressed himself along that line.

Dr. LITTLES. I totally agree that we cannot take cuts recklessly, that we must understand them when we take them, and we're very conscious of that.

One of the things that we are doing is that when we make changes in this program, when we reduce work force, and this gets back to what Dr. Mark said in his testimony, when we cut the work force, we're going to cut a task so that that individual is not required any more to do work.

If we didn't do that, then we would run a risk of safety. And we are looking at every task that's being done.

Mr. HALL. I'll get back to you. My time's expired. I yield back what I have.

Mr. SENSENBRENNER. The gentleman's time has expired. The gentleman from Florida, Mr. Weldon.

Mr. DAVE WELDON. Thank the Chairman. Last month, I had a day long town meeting with the employees of Kennedy Space Center, and one theme that was mentioned repeatedly is the concern over the safe operations of the shuttle.

Now these are the people on the frontline. I believe they know the dangers and they know about the safety concerns firsthand.

The concerns that I have heard from some of those workers in the trenches is that the direction that NASA is taking towards a new reorganized shuttle program may not provide the structure necessary for retaining the same dedication to safety.

A good example is what happened last month with the problem with the O-rings, and I think it was clearly demonstrated that people came together and were able to identify the problem and make the necessary corrections.

And I'm concerned about the possibility that we may be sacrificing that kind of ability in this reorganization effort. My first question I'd like to direct to Dr. Mark.

You stated in your testimony before this Committee back in March that you fully supported NASA's efforts to move to a single prime contractor, something you actually advocated ten years ago.

You go on to express your concern about safety and your belief that its consideration should be an integral part of any movement to a single prime contractor.

My question is, since the shuttle is taxpayer owned, what would you see as the appropriate roles for NASA and the new single prime contractor with respect to safety of the shuttle?

Dr. MARK. Dr. Weldon, let me give you some similar programs that are government-owned but operated by private contractors that have safety problems but perhaps not as important as the shuttle because of the high visibility.

The Titan launch vehicle, which the Air Force uses for its heavy payloads, is operated out of Vandenberg launch site, Vandenberg Air Force Base launch site in California. It is a contractor-operated vehicle. It is operated by the Martin Company under contract to the Air Force.

There are very, very few Air Force employees involved in the operation of the Titan vehicle. It is a contractor operation. It was transitioned years and years ago.

We've done this before. I think that the problems that you are hearing from your constituents are serious.

And let me repeat what I said a little bit earlier. If you make a transition from a government operation to a contractor operation, the important thing is to do it quickly, don't stretch it out more than it has to be stretched out, and I defer to my friends here on the details. But you must do it as quickly as possible because you have to reduce uncertainty.

Morale has to do with fear of unemployment, with uncertainty, and it is absolutely essential that the management tell the people working on the program, as soon as they know what's going to happen, how things are going to go.

And speed is essential. Somebody said the thing has to come to a new equilibrium. It can only come to an equilibrium if there is

a degree of certainty and I think that's, to me, the most important factor, to do it quickly.

Mr. DAVE WELDON. General Stafford, would you like to comment on that question?

Lt. General STAFFORD. Well, with respect to the morale for the workers as you go through this reduction in force, we've had several experiences with this in the past, and one was after the first launch landing, Apollo 11, and I was chief of the astronaut group at that time.

And we were concerned that the quality of the work and the safety on the launch vehicles in those two space craft, the lunar module and the command module, would suffer. But in spite of the drastic cutbacks we made in the work force at the Cape, the quality was maintained throughout.

There's always minor instances where you can have failures, and that is part of human space flight. But overall, with that big downturn, by and large we did it fairly well.

Of course, you had the Apollo 13 issue, but that was set up really to start with a factor in California before we ever got there.

Now, in my own instance, on my first launch attempt, a gas generator plastic plug was left in there, and it was signed off by two technicians that it was removed. And on that first launch attempt, the Gemini 6, Wally Schirra and I have the all time record for shutting down exactly T zero when the fire and explosion broke out down below, and we had the liftoff signal.

But yet, you know, they had checks and balances. So there is always a risk, sir. But I'm convinced that with the human reliability program that NASA has in place, with the positive approach, we can go through this downsizing and be productive. We have to be very judicious, and I think members of this panel have all said that.

But I've experienced it before. We had that after Apollo 11, so the operations, in my viewpoint, can be streamlined and done safely.

Mr. SENSENBRENNER. The gentleman's time has expired. The gentleman from California, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman. Let me just ask a couple of questions of Dr. Littles.

Dr. Littles, you testified earlier this year before the Senate Subcommittee on Science, Technology and Space, that you had implemented programs to reduce the cost of shuttle operations and you thought the Kraft task force had identified additional sources of savings, but you then said, I do not know how we can accept additional challenges beyond the level of the President's funding plan, and I can assure you that the shuttle program will not agree to funding levels that jeopardize safety.

Now my first question is, is that still your view, and have you made all the cuts that you think you can make?

Dr. LITTLES. It's certainly my view that we will not agree to levels that jeopardize safety.

As we have gone through the process of putting together the '97 budget, which is now being worked, we have looked at everything in the program relative to content and changes can be made in our assessment, what we can do with the restructuring activity which

includes, by the way, more than just a single prime. It also includes requirement changes and other things.

When that budget is submitted, what you will see will be the budget that we think is the bottomline. I don't believe we can go below that.

Now there may be in the out years some things that we cannot see now that might evolve from this restructuring to give us increased reductions, but with what we've done to this point, and with what we extrapolate with the changes that are currently going on, we don't know how to go beyond that.

Mr. BROWN. Well, I'm not quite sure that that answers my question.

I don't know what's in the President's '97 budget. But you said with regard to the '96 budget that you couldn't go below that.

I'm—I don't know whether the '97 budget contemplates the additional billion and a half reduction which is in the budget act that we passed earlier this year, or not. So I can't—

Dr. LITTLES. It's about a billion.

Mr. BROWN. It's about a billion?

Dr. LITTLES. Yes, sir.

Mr. BROWN. You think you could absorb then another billion dollar cut in the program over the next five years?

Dr. LITTLES. That's a billion dollar in run out, yes, sir.

And the '96 budget, addressing that, we have carefully assessed our reserves that we have. We have some overrun that's coming through from '95, and we can take, we assess not more than \$50 million beyond what was submitted.

Mr. BROWN. Well, we are within striking distance then. You have apparently thought you could accommodate a billion but not a billion and a half. Is that right?

Dr. LITTLES. Yes, sir.

Mr. BROWN. And you don't have any suggestions at this point, obviously, as to how to cut off another half a billion.

Dr. LITTLES. No, sir.

Mr. BROWN. You're holding that until you really have to face it?

Dr. LITTLES. No, sir. As I said, we have looked, what we have done to this point in time, we've looked at everything that is in the program, all the content, how we can restructure, and we know no way to go beyond that.

Mr. BROWN. All right. Now, have you calculated the amount of job losses that would occur to meet that figure that you've just mentioned, and where those job losses would be?

Dr. LITTLES. No, sir, I can't give you numbers on that.

Mr. BROWN. I'm talking about the one billion that you suggested was your bottom line now. That's still going to require some more cuts in jobs?

Dr. LITTLES. Yes, sir, it is. And I can't give you a number on total job losses. We've looked at that in total but I don't have those numbers in my head.

Mr. BROWN. Okay. Well, I don't want to belabor that point, but I, and I'm sure all the other members of this Committee, don't want you to get to the point where safety is endangered. We don't know where that point is.

We have to depend on you, all of you, who are far better qualified than we, and perhaps Dr. Weldon, who is in much closer contact with the employees there could offer some insight based upon that.

But as far as I'm concerned, and I hope I'm not any worse than anybody else, I have to take the judgment of people who are closer to it than I am, and we don't want safety to be endangered.

Now that raises, however, another problem. If you feel that you've reached your bottom line, and you're still forced to take additional cuts, I don't know where they're going to come from, but they're going to have to come out of NASA's hide somewhere probably.

And that bothers me because we're already forced to cede the reduction of some other programs, and as I've pointed out many times, the more programs we have to cut, whether it's in aeronautics or global warming or whatever, the more we endanger the coalition that supports the total NASA program, which is what I'd very much hate to see happen.

Mr. SENSENBRENNER. The time of the gentleman has expired. The other gentleman from California, Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you, Mr. Chairman. I would like to commend you for holding these hearings, and also the leadership that you've provided in these last few months.

The importance of these hearings are underscored by the fact that we do have the Chairman of the Committee who was here earlier, and the distinguished former chairman of the Committee, Mr. Brown, is here.

Ralph Hall of course was the chairman of this subcommittee, is paying close attention to this particular issue.

Of course, we have Mr. Weldon who is a young man with a mission, and it has something to do about keeping America the number one space power.

And all of us look at this as an important issue, and what are we going to do, and how we move forward with the shuttle system and shuttle safety.

First of all, let me note that I believe that the shuttle is a marvel in space technology. I mean, all those people, all the astronauts flying it are heroes, and all those people who make that system go are just, we owe all of them a standing ovation.

But let us remember this when we're talking about the shuttle and this. The panel can correct me if I'm wrong. But the shuttle was meant to be basically a prototype, and it was basically a technology demonstrator that we have actually brought into play as a functioning system.

And as such, doesn't the shuttle have some built-in risks, that had we had something else in mind in developing it, we could have taken those risks out of the shuttle? I'll just throw that at Dr. Mark first.

Dr. MARK. I was with NASA during most of the development period of the shuttle, so I could answer your question in great detail, but it would take half an hour.

What I will say is that the shuttle was originally intended as an operational vehicle. It was not intended as an experimental vehicle.

In the process of developing the shuttle, we learned that we were operating some of the systems closer to the edge than we originally thought would be necessary.

And I'm talking here about the engines, for example, and some other systems.

We are in the process, as Dr. Littles said, of upgrading some of these things, and I believe that the Space Shuttle is in fact an operational vehicle. It is not an experimental system.

The reason why people sometimes say it is an experimental system is because we make improvements on it that are characteristic of what you do with experimental systems.

Mr. ROHRABACHER. Dr. Mark, I was a reporter in Los Angeles when the shuttle was first going through this whole maze of congressional approval.

I remember when Senator Tunney, at the time, at a press conference, and I believe it was Downey, and I do believe at that time they told us—it was a long way back—this would be the first vehicle and it would lead to other vehicles, once the technology was proven.

Dr. MARK. Well, it certainly will lead to other vehicles. I think we are right now working on advanced space launches that will take the place of the shuttle, but it takes awhile to develop these things, and my guess it'll be eight or ten years before something comes in that will take people into space, that will do it more efficiently and more effectively than the shuttle.

Mr. ROHRABACHER. To be more specific, we know that there are some, being the incredible jump in technological capability that the shuttle was, which, before the shuttle, we didn't have this capability, now we do. There are risks built into that.

We understand the risks, and I guess I would say, how could we move forward to streamline the shuttle system, realizing there are risks in the system, rather than just having review after review after review to oversee those risks? Is there any other way to approach it?

Dr. MARK. I believe the NASA plan to turn the operation over to a contractor is correct. One thing that will happen is that you will bring new people into the operation that will have ideas that we don't have now. That's one of the advantages of having a contractor system, a competitive contractor system.

So I think what you're looking for, Mr. Rohrabacher, is actually going to happen.

Mr. ROHRABACHER. Well, in terms of the approach that we take—now, by the way, just to note that the current cuts that we're planning to make, that the republicans have suggested, I believe were part of the President's budget, so it's not like this is a partisan issue where the President's on one side and we're on the other.

Is it better to do, would it be better basically to look at the shuttle and have specific changes that we are looking at, or would it be better to go at a general approach and say, we have so much less money?

Dr. MARK. I think I better defer the answer to that question to the individual responsible for running the system.

Wayne?

Dr. LITTLES. Well we do have certain portions of the funding that are devoted to changes in the system.

For example, we have upgrades that are specifically improving safety. You are familiar, I'm sure, with the alternate turbo pumps we've put in place, the wide throat and single coil heat exchanger.

We have things in place in the program right now that upgrade safety. We also have changes that are being made to provide increased performance so that we can meet Space Station requirements.

So we do have portions of the budget that are dedicated to those kind of changes, and then the other portions of the budget are dedicated to operations.

And when we look at changing or reducing the budget, we look at the content and the activities that are going on and address those specifically to see where we can take changes, if we can.

Mr. ROHRABACHER. Thank you very much.

Mr. SENSENBRENNER. The gentleman's time has expired.

The gentleman from Indiana, Mr. Roemer?

Mr. ROEMER. Thank you, Mr. Chairman.

Dr. Littles, this oversight hearing is concerned about a number of things. Certainly safety is at the top of the list, as well as the morale of the astronauts and the fine people that we have working at NASA.

A number of people are very concerned about safety and the risks that are taking place, or might take place, given the budget cutbacks.

I received an anonymous fax from NASA employees, it was actually faxed from Office Depot, rather than a NASA facility, and there are a number of questions that NASA employees are asking about drastic cuts and threatening the safety of the shuttle fleet and the morale of the astronaut corps.

Are you concerned about the impact upon morale and safety?

And certainly I would like you to be more specific than you've been with Mr. Sensenbrenner and Mr. Brown.

Are you going to be cutting safety personnel at Marshall, Johnson, Kennedy?

Dr. LITTLES. Again, we're not going to cut those aspects of the program that assure us we have safety of flight and that we can commit to each flight safely.

We're going to continue to look at all the details we look at now relative to the hardware and the anomalies that might occur. The government work force will still look at all the problems that we do now.

Mr. ROEMER. Sir, what are you going to cut?

Mr. SENSENBRENNER. Will the gentleman yield at this point? I'll give you some extra time.

Mr. ROEMER. I'll be happy to yield.

Mr. SENSENBRENNER. As we all know, Mr. Goldin has been aggressively promoting buyouts of NASA employees. We've had I think two rounds of buyouts completed.

And I'm concerned whether experienced NASA employees who have line responsibility for shuttle safety have accepted the government's buyout offer, for example, in greater proportions than people in other areas of NASA who do other things.

So we end up having a NASA that is top-heavy and people that have got other responsibilities, and quite a bit short of people who have got experience in the safety area.

This subcommittee has got no information on how this buyout has fallen, and we very well could end up short with the number of people that we need for the various items that NASA does, while meeting the goals of reducing the NASA work force through the voluntary buyout program. And I thank the gentleman from Indiana for that.

Mr. ROEMER. Dr. Littles, you know, you've been tasked with the request of cutting your budget. Now that's a significant task. Five billion, \$1.5 billion. You have stated that to accept additional challenges beyond the \$5 billion you cannot, you're not sure that you can assure funding levels that might jeopardize safety. What are you going to cut?

Dr. LITTLES. What we're doing is that we're looking again at all the tasks that people do. Some of those tasks on the government side are daily supervision, surveillance and oversight and management on a day to day basis of operational tasks.

In our judgment, we don't need in today's world, with the experience we've had with the shuttle program and the hardware, that many government people managing day to day contractor tasks. Those are the kind of things that we're going to cut on the government side.

And we're only going to cut those tasks where we can do it and not compromise safety.

Mr. ROEMER. So you don't have any specific examples for me of what kinds of level jobs and where they're going to be and what kind of target you're going to reach?

You're just telling me that you're not going to compromise safety, but you're going to come up with another \$6.5 billion in cuts across the board?

Dr. LITTLES. No, sir, not \$6.5 billion, not in the shuttle program, no, sir.

Mr. ROEMER. No, I'm not saying—five billion's across the board, 1.5 is in human flight.

Dr. LITTLES. Yes. One additional billion for human space flight is what we've incorporated in the budget.

Mr. ROEMER. Well, let me tell you what I'm concerned about, sir.

Mr. Johnstone's testimony pointed out that, in March, Endeavor was launched missing some washers, missing washers. Not that they were defective, they weren't anywhere on board. Now that's one problem.

A second problem is is that workers certified that they'd put these washers on board.

Now you're telling me, without giving me any specifics, that you're going to cut back on some of these government workers. We don't know who they are, where they are, what space center they are.

I'd like to know. I'm kind of worried about that and the impact on the safety of the shuttle program.

Secondly, what happened to these three people? They're two contractor and one NASA employee who certified that those washers were installed?

Dr. LITTLES. And those workers, the hands-on touch labor people who do that kind of work are not the kind of individuals and tasks who will be cut out of the program.

And the reason I can't give you specifics on exact numbers and exact tasks is that this is a work in progress. We're going right now, as I mentioned earlier in my statement, through every task that the government work force runs.

Mr. ROEMER. Okay, you've said this to me.

What happened then to the three workers that certified that those washers were on board?

Dr. LITTLES. Well, they're still on the program.

Mr. ROEMER. Were they disciplined? Were they held accountable in any way?

Dr. LITTLES. They were certainly held accountable for that.

Mr. ROEMER. How were they held accountable?

Dr. LITTLES. By their supervision.

Mr. ROEMER. What'd they do?

Dr. LITTLES. They were not given time off. There were reprimands.

Mr. ROEMER. They were not given time off, so they weren't given time off, they were just, something was written in their file, don't forget the washers next time?

Dr. LITTLES. And there was a very careful investigation of that, yes, sir.

Mr. ROEMER. Mr. Johnstone, would you agree that if we're going to hold people accountable in the NASA program, that that's the appropriate action to take when somebody has certified that washers were on board a shuttle flight, and then they weren't? What do you do in that kind of circumstance?

Mr. JOHNSTONE. Not being party to the investigations that Wayne refers to, it would be pretty hard for me to say what you'd do.

If what you're looking for, I seriously doubt that you fire them. You might look back and see whether there's something wrong with the training program. Certainly they would get a reprimand of some sort.

I can think of other cases, not necessarily on the shuttle but in the airline industry where the same things have happened.

Our concern basically I think is a climate of unrest of concern in employees may lead to things like this. In fact, it's probably more than may, it will.

Mr. ROEMER. So you, sir, are more concerned about the climate and not resolving the disciplinary action that you might take?

Mr. JOHNSTONE. Well, I don't think you can run—I don't know all the details of the investigation and under what circumstances this happened.

There have been cases, again not on the shuttle, where people saw a washer that was supposed to be installed on a work table in the process of being installed. He turned away, and when he came back it wasn't there. He assumed that it had been installed. He didn't see it installed.

These are difficult things to do. And Dr. Mark referred to it, and I can do it maybe in a little blunter language. You don't inspect quality into a product, you build it in. And what Wayne is talking

about is I think, as a result of the Challenger accident, we put levels of inspection and multiple levels of inspection into the space program.

You don't really need multiple levels of inspection. You need the guy to build it right in the first place. And then in the process, assure yourself that he built it right in the first place. But you don't need five people in different layers looking at it to make sure it's built correctly.

The problem we see, from a safety point of view, is the guy whose building it is the one I worry about. And if his morale goes down, if his attention goes down, then you better look out, you might have a problem.

Mr. ROEMER. You think we have a serious morale problem now?

Mr. SENSENBRENNER. The gentleman's time has expired. The gentleman's time has expired.

Mr. ROEMER. Is that including the additional time the Chairman gave me?

Mr. SENSENBRENNER. You got a couple minutes over and above that.

Mr. ROEMER. Thank you, Mr. Chairman.

Mr. SENSENBRENNER. Showing how big-hearted the gentleman from Wisconsin is toward the gentleman from Indiana. The gentleman from Michigan, Mr. Barcia, who has been very patient.

Mr. BARCIA. Mr. Chairman, thank you very much. I was just kind of listening and don't have any questions, but thank you.

Mr. SENSENBRENNER. Well, that concludes the first round of questioning. Is there any member of the subcommittee that would like to ask a second round of questioning.

Mr. DAVE WELDON. I would, Mr. Chairman.

Mr. SENSENBRENNER. The gentleman from Florida, Mr. Weldon.

Mr. DAVE WELDON. Before getting to my question, I just want to mention to the gentleman from Indiana that I received the same fax you mentioned, and I'm familiar with the Home Depot, exactly where it came from, as a matter of fact. And I will be passing some of these questions on to the members of the Committee to get some written responses from them.

And I'd also like to extend an invitation to you perhaps to come down to Kennedy Space Center at some point during the process, as well as any of the other members on the minority side, to hear from the rank and file. Because I personally found it to be a very illuminating thing to do.

Mr. SENSENBRENNER. If the gentleman from Florida will yield?

You know, let me say that I think that Dr. Mark has hit the nail on the head. And the sooner NASA can level with the employees about what's in store in this restructuring, the better off the entire operation will be.

This restructuring is not new. The direction that was given to the NASA administrator occurred in January of this year, from the Office of Management and Budget. And I don't think it's fair to have employees who have been devoted to NASA as an institution and given the most productive time of their lives to making America number one in space, to be left dangling in an indefinite period of time.

Now I recognize that these changes take some time, but I think if NASA would even come up with a time line and give interim reports on how this is progressing, much of the morale problem that NASA employees are facing would be solved.

And I'm hopeful that when Dr. Littles comes back for our resumed hearing some time between now and the time that Congress adjourns, we will have those types of time lines and that type of interim report because the best thing to beat rumors is the truth.

And there have been lots of rumors and very little facts that have been placed on the table on this. The gentleman from Florida.

Mr. DAVE WELDON. Well, Mr. Chairman, you just anticipated my next question to the panel, and I was going to start with Dr. Littles.

In the process of implementing this change, going to a single prime contractor, have you developed any milestones that you want to see implemented?

And if not, can you think of any at this time that you would want to see implemented in the process along the lines of the time line that the Chairman is talking about?

Dr. LITTLES. Yes, sir. We do have milestones. I mentioned some of those a minute ago, relative to putting the single prime in place. There are sub-milestones associated with that, associated with elements of the restructuring.

As I mentioned, we're going through all the requirements very carefully, and we will have those requirements reviewed and the changes should be in place by the end of this year.

I mentioned we're going through a review of all the detailed tasks. Each of the projects in each of the centers that have individuals working on tasks are going through those.

We will define those tasks that we will delete, continue, or transition by the end of the year. We'll have to understand that because that's a part of the request for proposal that will go out the first of next year for the single prime.

We're putting a new management structure in place, making streamlined changes. We'll have that done by the end of the year.

So, yes, we do have time lines for some of the things that are going into that.

Mr. DAVE WELDON. I guess in follow up to that, are you now developing these time lines in order to implement the budget constraints that are placed on you?

Or was it the other way around, that you had a plan and then the budget constraints were identified?

Where is the cart and where is the horse in all this I guess is my question.

Dr. LITTLES. Well, we're putting these time lines in place specifically associated with the restructuring. At the same time, we're responding to changes in the budget and it happens that some of the reductions that we're taking in the program are attributed to these changes that we're making.

So I'm not sure it's a cart and a horse kind of, they're kind of being done in parallel.

What we were talking about his changes in the budget in the out years, not in '95 or not in '96. We don't plan to do anything to the budget that we have in '96 except for the minor change that I men-

tioned that we've indicated we might be able to take. But these other things we will not be reducing budget in the '96 time frame.

Mr. DAVE WELDON. Do any of the other members of the panel here have any comment on that in terms of a time line or particular milestones that you would anticipate wanting to see from a proposal or a plan to actually implement this reorganization that you're talking about?

[No response.]

Mr. DAVE WELDON. If none of you have any feedback on that, I have a perhaps unrelated question for you, General Stafford.

You talked about the reduction in the funding that occurred in the Apollo program after Apollo 11.

Was the astronaut corps involved in the implementation of that, and the question I'm really leading up to, and I'd open this up to any of the members who want to comment on it.

In the process of doing this, you know, I'm concerned that we're not getting enough feedback from the rank and file but I'm also concerned that we may not be getting enough feedback from the people who are actually putting their life on the line and going up in the space shuttle.

Lt. General STAFFORD. Well, it was a challenge for—Deke Slayton headed flight crew operations and I headed the astronaut group. All the morale on these astronauts, not for the ones assigned to the mission, but because you had a bigger astronaut pool by far than we needed flight crew members. And that was the problem, the ones that were not going to fly. That was my problem as they cut back.

We always had a very active manned space flight awareness awards, an awareness program that is still very active today, and the astronauts were involved with it.

But, yes, we were always concerned on how we were involved in working safety, just like Dr. Mark said, the flight safety officer involved in the first squadron and a wing in the Air Force, same way in the Navy. We were involved there.

But the morale did not suffer on the astronaut group, and we had a very strong input as far as safety items on that.

Mr. SENSENBRENNER. The gentleman's time has again expired. The gentleman from California, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman. And I omitted the statement that I intended to make at the beginning, and it was in my opening remarks, praising you for arranging this and for having such a distinguished panel of members here.

Mr. SENSENBRENNER. If there's any objection to including that in the record, the Chair will take that up with the member objecting shortly after the hearing is over with.

Mr. BROWN. Now let me seek to clarify my original line of questioning. First, I need to make this personal statement.

I did not like the President's budget when it came out at the beginning of this year, and I made an ass out of myself, saying that that was too little.

And then I was undercut by NASA which says, well, they can live with that, no more. You understand that situation.

Now we've subsequently adopted the House Budget Resolution which has another \$5 billion in cuts beyond the President's budget.

And the intent of my questioning, the previous questioning to Dr. Littles, was to evaluate whether you could adjust to that additional \$5 billion, which included \$1.5 billion for the shuttle program. And I did not make that clear.

Now, Mr. Goldin has assured me that he cannot possibly live with any additional cut beyond the \$5 billion that's in the President's program. You have indicated the same thing now.

Now somebody tell me how you're going to accommodate an additional \$5 billion and the \$1.5 billion that it would cut out of the shuttle?

Dr. LITTLES. I'm sorry, but I'm getting a little confused with numbers. The \$5 billion?

Mr. BROWN. Is in the President's program. You've taken a billion cut to meet the President's budget.

Dr. LITTLES. And the one billion that I'm referring to is a part of that five?

Mr. BROWN. Correct.

Dr. LITTLES. Yes, sir.

Mr. BROWN. All right, now can you take another \$1.5 billion?

Dr. LITTLES. No, sir, no, sir. We cannot.

Mr. BROWN. Now that's the problem that faces the rest of you gentlemen.

I want you to tell me if there's any way that that can be accommodated, and if you don't know, say so.

But you're going to have to be the watchdogs over this thing, and when NASA says, well, we don't want to but we're going to cut another billion here and billion there, what's the impact going to be?

We're getting very close to the margin here. And I don't—this is not a partisan thing. I'm sure that people on both sides agree that we can't go much lower, and I've already made an ass out of myself saying we can't go any lower, and now the question is what do I do? Roll over and play dead, or what?

Dr. LITTLES. Well—

Mr. BROWN. Go ahead, say it. Roll over and play dead.

[Laughter.]

Dr. LITTLES. I won't accept any additional cuts beyond what we can take and do it safely, and I don't know how to put it any stronger than that.

Mr. BROWN. All right. But let me tell you what—the additional \$5 billion cuts, \$1.5 billion would come out of the shuttle, 2.7 would come out of Mission To Planet Earth, a billion in aeronautics research.

If you can't take your 1.5, then we add whatever you can't take to additional reductions in Mission To Planet Earth, and in the Aeronautics R&D.

I happen to be very, very fond of both of those programs. So where does that leave us? That's out of your bailiwick, I know. Does anybody wish to comment on it? Give me some moral support here or something.

[Laughter.]

Dr. MARK. Mr. Brown, I think what has to happen here is that one has to organize a debate on what kind of a flight rate one could support with the shuttle fleet, given a reduction of another \$1.5 billion for the next five or six years I guess is the runout here.

You could obviously take that kind of a cut, provided that you don't do what is now in the program. That is what we found when we went to the Air Force and did our safety review.

What the Air Force did was to take cuts. They reduced the number of airplanes in squadrons from 24 to 18. And then they reduced the number of people accordingly.

And then we asked them to fly missions over Bosnia that weren't in the plan.

Now that's the kind of thing that one has to do in order to answer that question. What kind of a flight rate can you support with that budget reduction in a safe manner. That's the question.

Mr. BROWN. All right. Now how do we organize that kind of debate?

Dr. MARK. I think Chairman Sensenbrenner could do it right here at the hearing that he's promised to hold in six weeks.

Mr. BROWN. Well, I have a great deal of confidence in the Chairman.

Mr. SENSENBRENNER. We will see the gentleman from California then.

Mr. BROWN. Yes, you'll see the gentleman from California then. Thank you very much.

Mr. SENSENBRENNER. Thank you. The gentleman's time has expired.

Wrapping this up, let me say that there's been a lot of finger-pointing relative to where the \$1.5 billion figure came from.

Before the Budget Resolution came up on the floor of the House, Chairman Walker and I had a meeting with Mr. Goldin and the folks from NASA in the Chairman's lounge over there. And he gave the \$1.5 billion figure from himself as a recapitulation of the amount of money that was necessary to meet the budget requirements.

And we accepted those numbers. So there was no real difference in the numbers between what Mr. Goldin gave us in in the informal meeting that was held in Chairman Walker's office, and the numbers in the Budget Resolution for manned space flight.

Where the House of Representatives and the Budget Committee in particular had a difference in the numbers was not in the manned space flight, but in the earth observation system where the House republicans, but not the House democrats, believe very strongly that EOS ought to be subject to the same faster, better, cheaper philosophy that Mr. Goldin has imposed upon the rest of NASA.

So I think that that has got to be clear in that the numbers that were in the Budget Resolution for manned space flight were suggested to us informally by the Administrator of NASA, and we accepted them.

Mr. ROEMER. Mr. Chairman?

Mr. BROWN. Would the gentleman yield, briefly?

Mr. SENSENBRENNER. Yes, I yield to the former chairman.

Mr. BROWN. And future, we hope.

[Laughter.]

Mr. SENSENBRENNER. Well, there we'll dispute that.

[Laughter.]

Mr. BROWN. Mr. Chairman, I don't have the same recollection of that meeting that you do.

Mr. SENSENBRENNER. Well, you weren't at that meeting.

Mr. BROWN. Well, in that case my problem is that apparently I'm not privy to meetings which would make some difference in the way I look at this. And I resent that, to be honest with you. Because it's going to affect the way I respond in a number of situations.

Mr. SENSENBRENNER. Well, that issue you'll have to take up with Chairman Walker because he was the one that invited members to the meeting. I came because I was invited.

Mr. BROWN. What do I call that kind of a response?

Mr. SENSENBRENNER. A truthful one.

Mr. BROWN. All right. We'll take it up with Mr. Walker. But the fact remains the same. If Mr. Goldin is giving you and Mr. Walker one set of responses and me a different, I'm deeply concerned about that.

Mr. SENSENBRENNER. And you ought to be concerned about that, and I'm concerned about that too. And, as you know, I have had some troubles with Mr. Goldin in the past relative to information that was given to me as the former ranking minority member of this subcommittee before I became the Chairman.

You know, we've got to operate on a level playing field with one set of numbers that are available so that each of us, as individual members of the Committee, can make intelligent decisions based upon the same set of numbers.

Mr. BROWN. I agree with you completely. I just hope that you're not trying to subject me to the same thing you think you were subjected to in terms of different numbers.

Mr. SENSENBRENNER. Well, this is the first that I've heard that there have been, there still are different strokes for different folks. And I hope that that ends. The gentleman from Indiana.

Mr. ROEMER. Mr. Chairman, can I participate in the second round of questioning?

Mr. SENSENBRENNER. If you wish to.

Mr. ROEMER. Thank you, Mr. Chairman.

Mr. SENSENBRENNER. The gentleman is recognized for five minutes.

Mr. ROEMER. Thank you, Mr. Chairman. Dr. Littles, coming back to the issue of safety, I just want to assure you that this Committee may disagree on a host of things, as you just understood the exchange between the current chairman and the former chairman, and we disagree occasionally on some other things as well, too. But there is complete agreement that NASA needs to be safe and efficient, and we want to see restructuring take place, and we don't want to see repetitive and duplicative bureaucracy.

We want to help you in these respects, but we do not want to hear you come up here and say, you know, we're not going to be specific on cuts and everything's fine. We can absorb five billion across the board, we can absorb another 1.5 billion on human flight, and everything is fine.

I hate to bring this up, but let me just read from the investigation of the Challenger accident, the report which I believe you testi-

fied on back in 1986. On page 154, under "findings," it says, and I quote:

"During the last decade, NASA has had significant decreases in manpower. A disproportionate reduction may have occurred in the safety, reliability, and quality assurance staff at NASA headquarters and at the Marshall Space Flight Center. Additionally, during this period preceding the Challenger accident, the Office of Space Flight also suffered a decline in staff. The decreases may have limited the ability of those offices to perform their review functions."

I brought up the function of the washers not being a part of the Endeavor flight.

I want to make sure that you understand that this is your opportunity to let us know if in fact you feel like there is jeopardy, if in fact that there is significant degradation of your ability to ensure safety.

And certainly by the faxes that we're receiving anonymously, there is some concern on the part of employees.

I want to make sure that you feel absolutely certain that—I don't want to see these offices of safety cut, but you feel certain you can come up with additional cuts.

Dr. LITTLES. We believe we can. And, again, we're going through the details. As we go through the details with this time line I just talked about a minute ago, if we find that we cannot take those cuts, then you will not find us here saying we can take them.

Mr. ROEMER. But you said that you were worried about another billion dollar cut five months ago, six months ago. Now you say we can do it.

Dr. LITTLES. Our assessment at this point in time is that with the changes we're making, and those changes again are not going to be changes that relate to safety, we're not going to take the safety organization and the safety process and the work that those people do and do away with it. We're going to keep doing that. As a matter of fact, we're going to improve the way we do that.

Again, what we're going to take out are those tasks that we believe we can do and take them out safely, and only those.

Mr. ROEMER. When can we see the details of these cuts?

Dr. LITTLES. You will see the details of how we plan to do that by the end of the year. We'll have all that laid out.

Mr. ROEMER. So the next time you testify, you still will not be able to provide us the projected cuts?

Dr. LITTLES. I will not be able to give you the details of all the numbers because we have a process in place in working progress to define all that right now.

Mr. SENSENBRENNER. The gentleman from Indiana has my commitment that we're going to have enough hearings so that this gets done right because that's the most important thing that I think we can do in terms of oversight over NASA is to make sure that safety is not compromised.

And I believe that every member of this subcommittee who participate in the hearings has a significant doubt, after listening to the testimony from NASA, that we're not sure that safety has not been compromised, and we're going to have hearing after hearing until every member of this subcommittee is convinced that safety

is not compromised. And the burden of proof is on NASA which is making the changes from a management perspective.

Mr. ROEMER. Thank you, Mr. Chairman.

Dr. LITTLES, in terms of writing a new contract for a prime contractor with the shuttle, what types of contract incentives has NASA found to be the most effective at establishing safety as a contractor's first priority?

Dr. LITTLES. We will continue to have a portion of the fee, award fee for the contract, directly associated with those things that relate to safety. The quality of the hardware, the performance of the system, those things will continue to be in the award fee process to give incentive to that contractor to ensure that we maintain safety.

Mr. ROEMER. Will there be negative fees?

Dr. LITTLES. We haven't addressed that, but we could put negative fees in it, yes, sir.

Mr. ROEMER. Does the Office of Safety and Mission Quality participate in establishing the incentives? Will they help?

Dr. LITTLES. Yes. They will be involved in that process, yes, sir.

Mr. ROEMER. I have a number of questions that I would submit for the record, Mr. Chairman. And again, I appreciate your time.

Mr. SENSENBRENNER. Without objection, all members of the subcommittee may submit questions to the witnesses for the record, and we would appreciate written responses within a three-week period of time so that we can complete the hearing record and send it off to the GPO for printing. So thank you all for coming.

I'd like to express my appreciation to all of the members of the panel for testifying on this very important subject.

I believe that this hearing was very positive in shedding light on the problems that exist in shuttle safety.

I would ask Dr. Littles to be in touch with the subcommittee staff on when you think you could come up for the resumed hearing.

And again, I want to have this before Congress adjourns, which we hope to be by Thanksgiving.

Dr. LITTLES. Yes, sir, we'll do that.

Mr. SENSENBRENNER. And without any further ado, the hearing's adjourned.

[Whereupon, at 3:15 p.m., Wednesday, September 27, 1995, the hearing was concluded and the Subcommittee recessed, subject to call of the Chair.]

[The following material was received for the record:]

Responses to written questions submitted by Cong. Hall resulting from the September 27, 1995, hearing.

QUESTION 1:

In view of the very challenging tasks that the Shuttle program will have to undertake starting in 1997 to assemble and supply the Space Station, how comfortable are you in having the Shuttle program undergo a major restructuring during that same time period?

ANSWER 1:

The transition to a single prime contractor and a restructured Space Shuttle program will be accomplished in a way which minimizes any difficulties during the Space Station assembly period. We are anticipating the prime contractor to be selected by September 1996. At that time activities that transition functions to the prime will begin. We want the prime contractor fully involved in the process, and to feel comfortable with the transition timelines and responsibilities. The transition will be a very deliberate, gradual process and it will take as much as five years to complete for some development and production contracts. The first year of that will be the most challenging as it will be the time when the new prime will be taking over responsibility for the majority of work in the program. They will also be establishing management relationships with new subcontractors. NASA will be in a "training wheel" mode during much of that time to insure a smooth, task by task, carryover of authority. By late 1997, when the first Shuttle flight to the international Space Station occurs, the "training wheel" period should be complete. After that, new work in the form of subcontracted hardware projects will be added to the new prime's responsibilities for a period of time. This could be up to a five year period, the approximate time at which the Space Shuttle Main Engine contract transfers from direct NASA management to prime contractor management. (See enclosure 1)

QUESTION 2a:

Regarding the personnel impacts of the budget cuts

Please provide the number of Shuttle related civil service and contractor jobs that have been eliminated, by Center, since FY 1992. Please identify the number of those jobs that were safety related.

ANSWER 2a:

The Space Shuttle Program work force, both civil service and contractor, has been reduced by 19% since FY 1992. The attached matrix reflects actuals for FY 1992 through FY 1995 and shows the distribution by Center (See Enclosure 2).

QUESTION 2b:

If the consolidation of the Shuttle contracts under a single prime contractor is to meet the cost reduction targets in the Zero-Based Review, how many additional civil service and contractor jobs will have to be eliminated, by Center? How many of those jobs will be safety-related?

ANSWER 2b:

We are currently conducting a bottoms-up assessment to refine the planning estimates for post-restructure civil service levels. This review will be completed by the end of the calendar year, however, we plan to provide you with a status at the November Hearing. We will be glad to provide you with the refined estimates when they are available.

We do not track civil service work force in the category you have requested, safety related jobs. As the line organization is responsible for safety, there are literally thousands of people who have direct or indirect responsibility for reliable hardware and safe operations. We do keep track of jobs in the safety assurance field (i.e. the Safety and Mission Assurance organization). Our assessment to date of personnel in the Safety and Mission Assurance organizations shows that the percentage reduction in civil service has been equal to or less than that for the whole program. By the end of the year, we expect to have an accounting of these jobs for your review.

QUESTION 2c:

How do you intend to ensure that the critical skills needed to operate the Shuttle safety will be retained in the face of planned and proposed budget cuts?

ANSWER 2c:

The primary means of ensuring that we do not lose critical skills is by carefully planning and managing the downsizing at every level. We depend upon project managers, and they depend upon their contractor counterparts for rational work force reduction strategies, including replacement plans for retirements and other attritions. We have no control over individuals, possessing critical skills, who decide to leave the government. They will be replaced, however, by reassignments, outside hire, or the position could be transferred to a contractor. There will be no arbitrary cuts of tasks. Each and every task reduction/transfer will be assessed by appropriate line managers for criticality. The process will also be monitored by the Safety and Mission Assurance organization which, as always, will be independently watching for safety issues in the program.

To further help this process, we are making use of the procedures for and baseline data from last year's Functional Workforce Review. You may recall that this task-by-task, person-by-person review was performed by senior NASA people who were independent of, yet familiar with the Shuttle program. They took inputs from program, project, safety, and support engineering personnel, both civil service and contractor. The primary purpose of the review was to verify that the previous three years worth of downsizing activities had not created any safety holes in the Shuttle program, or resulted in any loss of critical skills. The "bottoms-up" process, along with its database were then transferred to the various project managers with the intent that periodic follow-ups will be done to ensure that we haven't missed something in our restructure execution.

QUESTION 3:

Do you believe that the Probabilistic Risk Assessment model described by

Mr. Fragola accurately measures the level of risk in the Shuttle program? If not, what modifications would need to be made to the model?

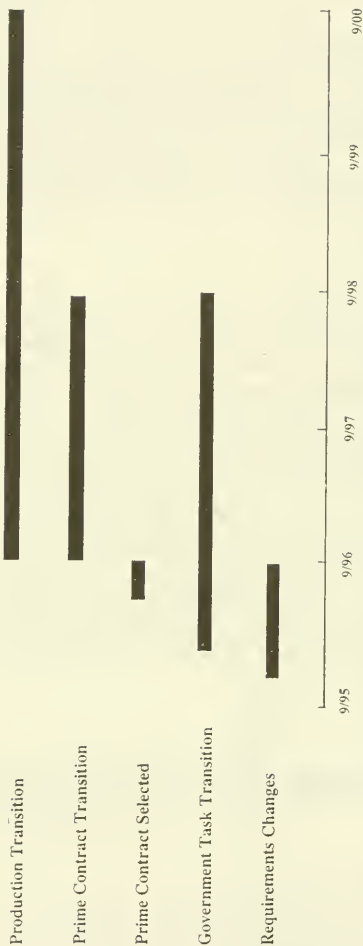
ANSWER 3:

NASA looks at the Probabilistic Risk Assessment as one of many tools for the manager to use in risk trades and other operational and programmatic decision making. The accuracy of the recent assessment done by SAIC is best stated by using the "Loss of Vehicle Uncertainty Results", published in their report. According to the study, the median probability of loss of vehicle is one in 131 missions with an uncertainty band ranging from one in 76 to one in 230. The accuracy of this assessment is more than adequate for its intended use as a baseline for comparative purposes, something that can be used in higher level trade studies. For the near future, the SAIC assessment will be more than adequate for its intended purpose without the need for changes.



TRANSITION

A Carefully Planned and Controlled Transition is Essential.



Timeframe for Transition

Space Shuttle Program Workforce
By Center, By Fiscal Year

10/23/95

	<u>FY 1992</u>			<u>FY 1993</u>			<u>FY 1994</u>			<u>FY 1995</u>		
	CIVIL SERVANTS	CONTRACTORS	TOTAL	CIVIL SERVANTS	CONTRACTORS	TOTAL	CIVIL SERVANTS	CONTRACTORS	TOTAL	CIVIL SERVANTS	CONTRACTORS	TOTAL
<u>TOTAL</u>	<u>3832</u>	<u>31648</u>	<u>35480</u>	<u>3751</u>	<u>29519</u>	<u>33270</u>	<u>3432</u>	<u>27239</u>	<u>30671</u>	<u>3098</u>	<u>25707</u>	<u>28805</u>
JSC	1413	10312	11725	1368	9667	11035	1316	8879	10195	1308	7774	9082
KSC	1393	9780	11173	1373	9697	11070	1194	8759	9953	994	8759	9753
MSFC	908	11193	12101	892	9808	10700	799	9051	9850	676	8642	9318
SSC	34	255	289	34	239	273	39	495	534	40	501	541
OTHER	84	108	192	84	108	192	84	55	139	80	31	111

- All numbers are in full time equivalent persons

- Contractor numbers are direct, indirect, and major subcontractors over \$2M

Responses to written questions submitted by Cong. Roemer resulting from the September 27, 1995, hearing.

QUESTION 1:

In its report on the Challenger accident, this Committee was "not assured that NASA had adequate technical and scientific expertise to conduct the Space Shuttle program." You testified that NASA "will maintain sufficient technical insight into contractor activities to insure independent assessments for safely committing to flight." How should the Committee measure NASA's steps to assure this outcome?

ANSWER 1:

Today the Government provides oversight and supervision of the day-to-day operations and program management over numerous contracts. When the program is restructured under the single prime contract, the government will not supervise day-to-day operations, but will have insight and conduct independent assessments of "out-of-family" conditions. The government will also conduct audits and perform surveillance to insure that operations are being conducted in a manner which maintains flight safety. We are developing a number of procedures and metrics which will identify safety of flight issues. The metrics or measuring tools will include in-flight anomalies, problem reports, hardware cannibalization, etc. In addition, we will continue the Certificate of Flight Readiness review process in which senior Space Shuttle program and NASA management are briefed on the flight readiness of all Space Shuttle elements. These measures to insure safety of flight will be incorporated into the Program Management Plan which is currently in work. We will be glad to brief you and/or your staff as this Plan matures.

QUESTION 2:

What types of technical activities will NASA maintain in-house to allow oversight staff to maintain their technical expertise?

ANSWER 2:

Each Center will maintain a core group of engineers who will be called upon as needed by the NASA Program Manager to provide insight into technical problems, anomalies, and other "out-of-family" situations. They will perform independent assessment of these issues to provide assurances to the program of the work performed by the contractor. Also, they will perform audits of contractor functions and processes. The fields of expertise will include (but will not be limited to) propulsion, software design, flight dynamics, flight control, flow dynamics, structures, safety, reliability, quality assurance, thermal, metallurgy, etc. Many of these people will spend full time on Shuttle tasks. Others may be used only part time on Shuttle but will retain their functional expertise by working similar tasks on other programs. Further, there will be certain critical flight execution jobs retained by civil servants. Examples are Mission Control flight controllers and Flight Directors, Test Directors, Launch Directors, flight crewmembers, and crew surgeons.

QUESTION 3:

At the request of this Committee, the General Accounting Office has been evaluating risk management in the Shuttle program. In a briefing for staff, they indicated that NASA has succeeded in establishing open communication channels within the program. If NASA is to restructure program management, GAO describes certain principles they believe should be carried over:

- Open discussion of safety concerns;
- Sufficient parallel reviews and communication channels;
- Program priorities that place safety over schedule or cost; and
- Management information systems that are accessible, and provide accurate and complete data in a timely manner.

Can we assume you agree that these principles should be reflected in whatever structure NASA establishes?

ANSWER 3:

You can be assured that all of the above principles will continue to be reflected in the restructured Space Shuttle program. As always, clear and open channels of communication are the basis for a healthy operation.

QUESTION 4:

How will NASA incorporate these principles in its intended Shuttle management structure?

ANSWER 4:

The Shuttle program, both contractor and civil service are very sensitive to these issues. We will continue to stress to all levels in the work force the program priorities: Fly safely, first; meet the manifest, second; and reduce cost, third. With safety of flight our top priority, both contractor and NASA have established independent reporting system for safety issues. Employees are encouraged to report any condition with which they feel uncomfortable. Also, there is a system which allows employees to report safety issues anonymously. Program reviews and the Certificate of Flight Readiness reviews will continue to maintain communications and exercise program accountability.

QUESTION 5:

In July of 1993, NASA released a study of the work force at Kennedy Space Center. It concluded that human error was a primary cause of Shuttle mishaps, and that workers were afraid to report errors for fear of being laid off as part of NASA's effort to reduce Shuttle costs. How do we fight that perception to maintain an open environment?

ANSWER 5:

As a result of the study referred to in your question, the Office of Space Flight and its contractors initiated a number of actions to maintain an open environment to encourage the work force to report incidents/mistakes. Today, employees are

rewarded and/or given positive public recognition for reporting their mistakes. A recent example featured an employee who, while working in the orbiter payload bay, stepped on and damaged a metal structure. Only the employee knew about the incident, but he immediately reported to the supervisor what had occurred. Contractor senior management, that day, held a meeting of the employee's peers in the shop area to publicly praise the individual for reporting the incident. No disciplinary action was taken. On the other hand, severe consequences (including dismissal) are dealt to any employee who is caught trying to cover up an error. NASA and contractor management make frequent appearances at the workplace to communicate these policies while developing closer working relationship with employees. Additionally, the Space Flight Awareness program actively promotes safety and quality throughout the Space Shuttle program. This program rewards both contractor and NASA employees for their contributions to safe, human space flight.

QUESTION 6:

NASA has for the past few years disapproved the use of award fee "rollover" in contracts; contractors may not expect to regain fees not awarded because of poor performance. Does this policy remain in effect, and will it be incorporated into a contract with a single prime?

ANSWER 6:

Yes, the "rollover" policy remains in effect. For the single prime contract, called the Space Flight Operations Contract, the rollover approach will not be applied. However, there are other mechanisms to motivate the contractor by the use of our planned award and incentive fees provisions.

QUESTION 7:

Will it be possible to develop a fee structure in this contract that incorporates significant fixed-price fee provisions? Given our experience in conducting shuttle processing, haven't we passed the point where we can reasonably anticipate the costs involved with a fair degree of accuracy?

ANSWER 7:

A cost-plus-award fee/incentive fee contract is planned which motivates high technical competence and economical performance. The award fee portion of the contract will be used to insure that proper attention is paid to performance, safety, quality and schedule. The incentive fee portion will provide incentives to reduce costs.

QUESTION 8:

Contract management at NASA has been under study by the General Accounting Office as a "high-risk" area. How will the agency assure that contracting officers aggressively monitor contract performance to protect the interests of the Government?

ANSWER 8:

NASA will ensure that this contract receives the utmost in management attention at all levels, not just at the level of the Contracting Officer. The dual nature of the award fee/incentive fee approach will serve to motivate the contractor to perform quality work most efficiently. The innovative use of a performance type statement of work is planned which will result in a work requirement structured to identify, in detail, specific work outputs and standards.

QUESTION 9:

After the Challenger accident, it could be argued that NASA rewarded Thiokol by awarding them a \$400 million contract for redesign of their flawed motor. The \$10 million penalty for causing the loss of a \$2 billion orbiter was deducted from the award fee in this additional contract. You testify that, [W]e will improve safety by focusing contractor accountability and responsibility. How will this be accomplished?

ANSWER 9:

We will focus contractor accountability by removing NASA management from the various project level contracts, and directing that work as assigned subcontracts in most cases to the prime. This will give the prime contractor responsibility for work that today is held by many NASA project managers. The ultimate responsibility, however, will still rest with the NASA program manager, to whom the prime contractor will report. As for fees and penalties, the fee plan will be a cost-plus-award-fee with an incentive feature for cost savings. It will also have a strict penalty clause to cover high value losses found to be the fault of the contractor. The details of this plan are still in work.

QUESTION 10:

How does NASA anticipate it will handle the question of liability in the case of a operational accident?

ANSWER 10:

In case of a major accident, NASA will convene investigation boards that fit the severity of the mishap. A NASA led safety investigation will determine cause factors and make recommendations to prevent future occurrences. Concurrent investigations will be conducted by the Inspector General and/or the General Counsel for cases involving potential fraud, waste, abuse, or other improprieties. To the extent that the NASA investigation reveals a breach of contract, or a contractor caused loss of life/mission/vehicle, the appropriate penalty will be levied per the contract.



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October 30, 1995

Subcommittee on Space and Aeronautics
Committee on Science
2320 Rayburn House Office Building
Washington, DC 20515

Subject: Answers to the Questions Posed by Hon. Ralph M. Hall

Dear Mr. Hall:

Thank you for your attached questions dated 27 September 1995 which I have just received today. For the sake of clarity, I would like to respond to your questions in the order you have asked them. In the cases where multiple questions were contained I have separated them and attempted to respond to each in turn as follows:

1A. How does your risk assessment take account of new information such as the "O-ring" problem that surfaced earlier this year?

The risk assessment addressed this problem directly. What the analysis showed was that the principle areas of concern in the solid rocket remained in the joints. However the design changes since the Challenger accident had reduced the risk contribution of the field joints. For this reason the igniter and nozzle joints dominated in the shuttle design which was analyzed at the time of the study. Subsequent design changes addressed the igniter joints. The changes left the nozzle joints as areas of residual concern. In particular joint number 3 in the nozzle was identified by the study as one of particular concern because the double O-ring seal although not a barrel seal was designed with both O-rings in the same plane. This implied that the redundant seal might be susceptible to correlated or "common cause" failure. Such a failure would be caused by any initiating condition which would have the potential of defeating or penetrating both seals. When discoloration or "cooking" of the first O-ring was observed the concern was the escape of hot gases from that double seal due to foreign debris which might violate both seals (e.g. a hair crossing the double seal boundary). Because the nozzle joints are assembled in a factory clean room environment, (as we observed at the Thiokol plant in Utah), the probability of a correlated failure due to thermal exposure of the first O-ring was assessed as minimal.

However what was observed in the recent missions was erosion of the first O-ring. Such erosion is an indication of the existence of a hot gas jet impinging upon the first O-ring and, if sustained, would constitute a significant correlated failure threat. The risk assessment indicated that the risk would be increased by more than a factor of three, if NASA chose to fly without either correcting the problem, (and thereby

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eliminating the initiating event) or by providing evidence that such a jet could not be sustained. NASA chose to restrain from flying until they could make changes which would eliminate this initiator. The risk assessment model clearly indicated the prudence of this action.

1B. How does the model take account of the recent hydrogen leaks?

The occurrence of hydrogen leaks is not a new phenomenon; a number of hydrogen leaks have been observed during testing. The test data however cannot be applied directly to flight for the following reasons:

- 1) During testing the engine is provided propellant from a feed system which differs from that on the space shuttle and thus has unique leakage failure modes.
- 2) During testing glow plugs are used to ignite any source of hydrogen leakage to prevent an explosion, usually leading the test engineer to scramble for the cutoff switch.

Both of these factors obscure or contribute uncertainty to the estimation of a catastrophic failure due to hydrogen leakage. The difference between the test and flight feed systems does not offer a totally applicable source for estimating the probability of a hydrogen leakage and the presence of the glow plugs artificially starts a fire which may not have occurred during flight.

The probability of a hydrogen leakage was obtained from an earlier study conducted by Lockheed which studied the propellant pressurization system. The probability for a hydrogen leakage derived from that study is 1 out of 2932 missions, however, this estimate is for leaks which are capable of causing hydrogen concentrations sufficient for explosion. In addition, since during flight the shuttle aft compartment is purged with nitrogen, a source of oxygen must also exist making the probability of a catastrophic hydrogen explosion due solely to leakage rather unlikely.

Therefore the fact that the latest occurrences of hydrogen leaks are part of a larger set, or are part of a set wherein the potential of an explosion given a leak is somewhat uncertain seems to indicate that the NASA concern with these leaks is conservative from the PRA perspective. However, hydrogen leakage from the coolant tubes was found to be a relatively high probability cause of premature engine shutdown.

1C. How does the model take account of major new design changes such as the introduction of the super lightweight aluminum-lithium external tank?

Proposed design changes which have direct risk reduction potential (such as the new oxidizer and fuel pumps and the new powerhead and MCC) are taken into account by identifying their risk reduction potential and thereby ensuring that the money spent for these potentially safety enhancing features is being spent in the correct area. This does not mean that we are certain to capture the potential risk identified by the risk assessment and thereby eliminate the portion of the risk

associated with the design changes. What it means is that from the perspective of the existing study the money has been spent in the correct areas. When design changes are directly performance enhancing such as the super lightweight tank it is the responsibility of the risk analyst to ensure that this design change has not eroded any of the safety margin which was assumed as a basis of the risk assessment model. This implies an additional assessment of the risk achievement value of the old design as compared to the new design. This was not considered in the existing study but could be easily incorporated in an extension to the study. In summary the present tank design is not a risk-driver and the risk assessment would have to be extended to ensure that it does not become one with the new aluminum-lithium design.

2A. Do you have any way to model the impact of major changes in the management structure or processing procedures such as are being proposed?

In principle the answer is yes. If the processing procedure steps could be related to risk areas in the shuttle mission and the effectiveness of those steps could be assessed in terms of their contribution to controlling that risk then the processing procedures could be ranked according to risk contribution. Those procedures which have been shown to be risk ineffective (within the risk margin) might be changed or eliminated. Also a risk monitoring system based upon a set of risk performance indicators which are directly relatable to observed anomalous condition failure precursors could be used to monitor the ongoing risk of the shuttle throughout the transition from one management structure to another. As was said in my testimony such a system does not yet exist but it is a natural extension of the current risk assessment model. If such a system were developed NASA could monitor the risk throughout the transition period and adjust the speed of transition in accordance with the risk performance measured by these indicators. If the risk performance (as measured by these indicators) began to degrade then NASA could slow the transition accordingly.

2B. How important are those non-hardware elements in determining the level of risk in the shuttle program?

This question must be answered from two perspectives. These are risk reduction and risk achievement. The difference can be explained by analogy. Risk reduction in a cantilever iron beam bridge structure is assessed by how much the risk is reduced if we add another beam to the structure. If the structure is already robust adding another beam would not reduce the risk by much so its risk reduction worth would not be very high. However, if a beam was removed then the risk might be increased substantially and therefore the risk achievement worth of a beam might be significant even though the risk reduction worth is not. In the case of the shuttle the current processing structure is important in maintaining the current level of safety in the hardware and therefore is very important in preventing the level of risk from increasing given the current system. However this does not mean that a transition could not be made to a much less labor intensive system and still maintain the same level of risk or even reduce the risk. Commercial airline experience has shown that if flight experience can be appropriately incorporated into between flight processing by monitoring carefully the risk impact during the transition then the level of direct intervention between flights can be reduced while also reducing the risk.

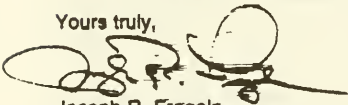
In the shuttle case since we do not have the massive flight experience of the airline industry if we wish to reduce the non-hardware elements (i.e., reduce the between flight processing labor and other resources) this can only be done if we expand the flight experience. To do this we have to include precursors to flight failure and establish a set of risk indicators based upon an expansion of the current shuttle risk assessment which would allow us to monitor the contribution of changes made in the non-hardware elements to risk. Such a system would provide a "risk meter" for NASA to use to assess the affect of processing changes on forecasted flight risk in terms of the observed risk indicator values. Risk meter systems are currently either in place or proposed in the commercial nuclear industry in both California and Texas as well as elsewhere.

In conclusion non-hardware elements are not so important in determining the level of risk in the shuttle program because the historical record of failures and anomalous conditions can be used to measure the past effect of the current non-hardware elements. However that is not the issue here. The issue here is: How important are changes to the current set non-hardware elements to the risk in the future of the Shuttle Program? The answer to this question is that they are extremely important, in fact, critical. For this reason it is believed it would be extremely imprudent to undertake changes to the current set of non-hardware elements without some measure of the potential ongoing risk impact of such changes. Also the transition from our set of non-hardware elements to another should be approached very carefully. It should be initiated first in those areas determined to be least risk sensitive, and the risk impact of the changes should be measured in terms of the feedback provided by the risk indicator set. Only when assurance is provided that the flight risk has not been adversely impacted should other changes be attempted and monitored in a similar fashion. It is believed that such a system of Risk Management throughout the transition might provide NASA and its oversight bodies with objective evidence that transition is proceeding in a risk prudent fashion.

I believe that the above response provides answers to your questions. However, if you require further clarification, or have any additional questions please do not hesitate to contact me.

Once again thank you very much for your interest.

Yours truly,



Joseph R. Fragola
Vice President and Manager
Advanced Technology Division

Attachment

cc: J.R. Bayster
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Additional Questions for Mr. Johnstone
Submitted for the Record
September 27, 1995 Hearing

by
 Hon. Ralph M. Hall

1. A June 15, 1995 Government Accounting Office report ["Space Shuttle NASA Must Reduce Costs Further to Operate Within Future Projected Funds"] stated that

"NASA appears to have adequately considered safety while implementing cost reductions to date. However, because Shuttle safety cannot be directly measured, it is difficult for NASA to know how much further it can reduce costs without affecting safety."

What are the indicators that will tell us when safety is being compromised?

Answer

Identifying absolute indicators which will provide an alert with respect to the safety impacts of cost reductions and personnel cutbacks is particularly difficult. When safety is a consideration, cost reductions and personnel cutbacks must be made slowly and with deliberation. Specific metrics to identify in advance when cost reductions have reached dangerous levels have not yet been developed, although the failure to achieve key milestones may be one indicator of potential problems. In addition, an increase in the number of human error incidents and their severity may also be possible indicators. The best source for data concerning safety impacts due to cost reductions and personnel cutbacks resides in the operations work force at Kennedy Space Center. It is important that NASA management pay close attention to the concerns being expressed by this work force since the earliest signs of potential safety impacts will be identified by those people who are on the 'flight line'. At the request of the NASA Administrator, the Aerospace Safety Advisory Panel continues to work with Kennedy Space Center and Space Shuttle Processing Contractor to monitor and review the Space Shuttle processing operations for possible negative trends.

2. In his testimony, Dr. Mark recommends that

"NASA must insist that the safety function be tightly embedded in the line management organization of the contractor chosen to operate the Space Shuttle."

a Do you agree or disagree with his recommendation?

b Under such an arrangement, how would we assure that safety considerations are insulated from contractor cost-cutting pressures?

Additional Question for Dr. Mark
Submitted for the Record
September 27, 1995

by
Hon. Ralph M. Hall

1. In your testimony, you support the consolidation of the Shuttle program under a prime contractor. What would complete privatization of the Shuttle program entail, and how practical do you believe Shuttle privatization would be?

The consolidation of space shuttle operations under a single prime contractor is a well-understood procedure. As I mentioned in my testimony, we operate other space launch vehicles (the Titan, the Delta and the Atlas) with single prime contractors. In these cases, and, as it will be in the case of the space shuttle, the government retains a contract oversight function. There is a competitive element in the prime contractor operation because different companies will compete with each other to be awarded the contract. Thus, the taxpayer can expect some savings over a government operation provided that the competition is properly managed. However, once the award is made, the contractor does not make a "profit" in the usual sense of that term. Rather, he is awarded a fee for the services he renders to the government. The government, of course, also reimburses the contractor for the full cost of the operation.

"Complete privatization" means something different. In this case, the organization that operates the shuttle must run things so that the organization sustains itself with income earned from shuttle operations. Hopefully, the organization would do a little better than sustaining itself and this would then make it "profitable". In my judgment, the space shuttle operation could not be "completely privatized" at the present time because the operating organization could not be sustained by the existing "market". What this means is that the government would have to heavily subsidize a "completely private" organization running the space shuttle. A subsidized "completely private" organization would not be essentially different from a "single prime contractor" because the government, through the subsidy, would actually determine the "profit". Therefore this "profit" is essentially equivalent to the fee earned by the single prime contractor.

The statements made in the previous paragraph depend on the "market". Today, the "market" for space shuttle flights is such that the statements in the paragraph are accurate. This circumstance could change. For example, if a very high value biological product were discovered that required the presence of humans in zero gravity to produce it, shuttle flights would become very valuable. Should that happen, then there would be a market to sustain "complete privatization". In terms of "safety of flight", my guess is that "complete privatization" would not be much different from the "single prime contractor" organization. The government would still have to establish safety regulations for the "private" organizations under the classic function of protecting the public. Thus, if space shuttle operations were "completely privatized" I would expect that a "Space FAA" would have to be established to look after safety of flight. This would not be a difficult thing to do and I would therefore expect that "complete privatization" could easily be done in such a way as not to compromise safety.

Answer

a. I agree that the safety function must be embedded in the line management organization but it is more important that the safety organization be independent and have the authority to make recommendations and decisions without regard to cost or schedule impacts. The safety organization should never be solely a staff function and must always have a direct line of communication to the top levels of management. A large part of the success of the Space Shuttle program since the Challenger accident can be traced to the ability of the NASA safety organization to remain independent while exercising the authority to stop any operations it believes are an unwarranted risk to the program. Any contractor that may operate the Space Shuttle in the future must maintain a safety organization with similar independence and authority.

b. First, I believe that safety is everybody's responsibility, from the front line technician up through the company president. If someone feels that safety has been compromised, then they must be able to freely express their concerns without fear of retribution. Second, NASA must assure that the contractor safety organization and the NASA safety organization have a solid line of communication to insure that problems and issues are quickly identified and the proper solutions implemented. Both NASA and the contractor must be fully committed to "safety first, schedule second and cost last."

3. Do you believe that the Probabilistic Risk Assessment model described by Mr. Fragola accurately measures the level of risk in the Space Shuttle program? If not, what modifications would you recommend?

Answer

Probabilistic Risk Assessment (PRA) can be an excellent management tool under the proper circumstances. However, the Space Shuttle program cannot and should not ever make critical safety decisions based solely on the results of PRA. In order for PRA to be effective, a reasonably large and sufficient data base must be obtained under a set of uniformly consistent conditions. In the case of the Space Shuttle program, these conditions do not exist. The PRA model described by Mr. Fragola could be used as a risk management guide but the decision on readiness to safely launch the Space Shuttle must, in the final analysis, rely on information and data communicated to the system managers. It must be stressed that PRA is based on numbers, statistics and probabilities and is not an absolute 'black or white' decision making technique. Therefore, the best source for making critical safety and risk management decisions will always be the launch operations and systems personnel directly involved with the day-to-day operations.

4. In view of the very challenging tasks that the Shuttle program will have to undertake starting in 1997 to assemble and supply the Space Station, how comfortable are you in having the Shuttle program undergo a major restructuring during the same time period?

Answer

While NASA has made considerable progress in meeting its goals for 're-inventing government', there is still much work to be done and many unknowns and issues to be addressed. Any major



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restructuring of a program as large and complex as the Space Shuttle will have perturbations. Under the existing conditions of budgetary uncertainties and downsizing, the reorganization of the Space Shuttle program will be more disruptive than is normal. Therefore, the Space Shuttle program restructuring must be accomplished deliberately and with extreme care. Evaluation of the changes implemented must be made at each step in the process before continuing to the next step. If it were possible, evolution to a more efficient and effective Space Shuttle program would be the preferred method. However, NASA has been directed by both Congress and the President to accomplish the restructure and reorganization in a relatively short period of time. During this same time period, NASA is also expected to assemble the International Space Station on a relatively strict time table and limited budget. The Aerospace Safety Advisory Panel has some concerns that NASA can fully meet its commitments without additional risks to safety. Because of our concerns, the Aerospace Safety Advisory Panel has established three special task groups to monitor the situation. The first group has been given the task of evaluating the Space Shuttle capability to support the Space Station assembly process and monitor the schedule manifest for potential problems. The second task group has the responsibility to monitor and review the NASA restructure and reorganization. This group will be placing particular emphasis on the transition to the single prime contractor for the Space Shuttle operations. The third group is responsible for reviewing the Space Shuttle processing and operations at KSC prior to, during and after the transition period. All things considered, NASA has accepted an extremely ambitious challenge and the last thing NASA management needs are numerous legislative "oversight investigations", panels of "outside experts" and media "scientist/spokespersons", who do not have the benefit of the depth of experience and knowledge residing within NASA and its contractor employees, constantly second guessing NASA's decisions and micro-managing its programs.



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